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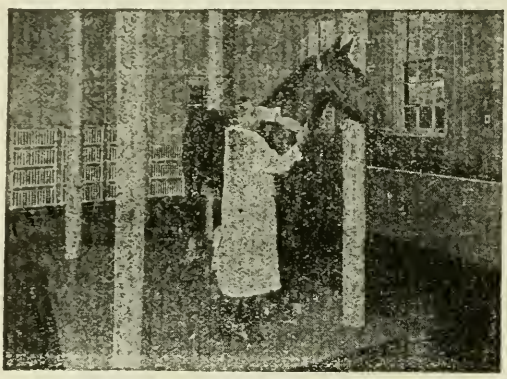

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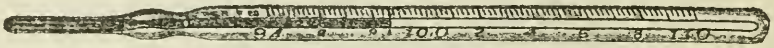

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THE
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VOL. XLVI JANUARY, 1920 NUMBER 1

ORIGINAL ARTICLES

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NON-SPECIFIC IMMUNITY[1]

BY COL. VICTOR C. VAUGHAN AND CAPT. G. T. PALMER, M.C., U. S. A.

IT STANDS out prominently in the records that the seasoned soldier is more resistant even to newly imported infections than the recent recruit. It is equally evident that the men from crowded cities resist these infections transmitted from and to the respiratory tract more successfully than their comrades from sparsely settled areas. Why did the rurals fall more ready victims to pneumonia than the urbans. Did it mean that the latter as a result of the crowd life, which they had previously lived, had acquired a degree of immunity by frequent exposure to those bacteria which cause the pneumonias. This is the answer which we were inclined to give after our study of the communicable diseases as they prevailed in our army during the winter season of 1917–18. However, since we know that there are many bacteria any one of which may induce a pneumonia and so long as we believe that bacterial immunity is strictly specific, it seemed necessary to suppose that each urban man had been exposed to each and every species and strain of this organism which may induce pneumonia and for a sufficient length of time to acquire a protective immunity. The epidemic of influenza during the fall of 1918 has shown, however, that the seasoned soldier is more resistant to an infection, new to the whole command, than is the man who has recently come into the service. This has raised in our minds the question: Is there any scientific evidence of the possibility of the development of a non-specific bacterial immunity, or increased resistance to infection. If this could be demonstrated, it would explain one of the problems which has troubled the student of epidemiology in both civilian and military life, especially the latter. We have seen that the assembly of large numbers of recruits may increase the army death rate more markedly than participation in active hostilities. In this frame of mind we have searched the literature of the subject of immunity for evidence

[1] Read at the Annual Meeting, The Association of Military Surgeons, St. Louis, Mo., Oct. 13-15, 1919.

bearing on this point, and we believe that we have found in certain researches made by the recently deceased Maj. Victor C. Vaughan, Jr., and first reported as early as 1905.[1]

We propose to briefly review this work and discuss its bearing on the possibility of the development of a non-specific immunity. Previously it had been shown by Vaughan, Sr., and Wheeler that bacterial cellular substances, both that from pathogenic and non-pathogenic bacteria, furthermore that all true proteins, bacterial, vegetable and animal, could be split by chemical agents into poisonous and non-poisonous fractions; that the latter is common to all proteins, while the former is specific for each protein. From experimental results obtained with these fractions, these investigators formulated their theories on the phenomena of infection, bacterial immunity, sensitization and vaccination.

Vaughan, Jr., attempted to establish immunity in animals with the poisonous and non-poisonous fractions of proteins. It is with the results obtained with the former that we are now concerned. The poisonous fraction, known as the "protein poison," is the same so far as the gross effects on animals are concerned, whatever the protein from which it has been obtained. By injecting this protein poison, beginning with a non-fatal dose and gradually increasing this amount, he found that a certain degree of tolerance could be established. On this point he wrote as follows:

> From a study of the protocols it can be seen that in the case of both guinea-pigs and rabbits after the administration of several doses of gradually increasing strength, a point is reached at which the animal is able to withstand the injection of from two to three times the amount which would have normally proved fatal for an inactivated control. This would indicate that during the course of treatment the animal had developed either a slight degree of immunity or had established a certain amount of tolerance for the poison. Which of these explanations is the correct one can be determined only after a careful study of the subject of the possible production of passive immunity and the demonstration of a possible antibody in the blood of the animals. At present, owing to the slight amount of increased resistance which the animals exhibit to the action of the poison, we are inclined to believe that the question is one of tolerance. Although the degree of tolerance thus far secured has been limited, we do not feel justified in concluding that greater resistance to the poison may not be obtained. There are many factors of primary importance in this work, all of which must be carefully studied before definite conclusions can be drawn. For example, the interval of time which is allowed to elapse between the injections is a matter of first importance. Since the length of time over which the poison acts is apparently so short, it seemed quite probable that any reaction which might occur on the part of the body would develop in a comparatively short time after the injection. With the object of determining whether this be true or not, animals were treated daily with gradually increasing doses with the following results.

[1] *Jour. Med. Research*, 1905, xiv, page 67. See also "Protein Split Products in relation to Immunity and Division. Lea & Febiger, 1913.

Here the protocol of these experiments is given and the results are stated as follows:

From this we see that it is possible to establish a certain amount of tolerance by means of daily injections of the poisonous protein. Here again we find that it is comparatively easy to resist a dose which corresponds to about twice the fatal amount, but above this the animal cannot be carried. When death results from a dose of this poison which is too large to be borne by the treated animal, the symptoms are identical in all respects with those which occur in the case of an untreated animal, and a fatal result follows in the same length of time.

We believe that Vaughan, Jr., was quite right in holding that his findings were due to increased tolerance of the protein poison and that this state should not be regarded as a form of immunity. It is non-specific. An animal which has been made tolerant of the protein poison obtained from the colon bacillus is equally tolerant of that from the anthrax bacillus or that from egg-white. The blood of the tolerant animal contains no antibody.

That a small degree of tolerance for the protein poison may be established in animals is in our opinion also shown by a study of the phenomena of multiple sensitization. An animal is sensitized to two or more proteins. After the proper lapse of time a small amount of one of these proteins is injected into the sensitized animal. This dose must be such that it induces anaphylactic sysptoms, but not enough to kill. The next day another of the proteins is injected into the animal. If the killing dose has been accurately determined, it will be found that the minimum fatal dose has been increased by the procedure of the preceding day. On the first day a non-fatal dose of the protein poison has been set free in the animal body, consequently a larger than the normal killing amount is required to kill on the second day. This demonstration requires a nice adjustment of dosage and the phenomenon was first reported by Friedbreger. *It is an established fact that an increased tolerance to the protein poison can be established, that it is non-specific and that no antibody is generated.*

Now we come to the most interesting and the crucial point of this study, and in doing so we will again quote from the article written by Vaughan, Jr., in 1905.

The question now arises as to whether these animals, which had acquired a tolerance for the poisonous proteins of the colon bacillus, were more resistant to inoculation with the living germs than were untreated animals. In order to ascertain this point, guinea-pigs which had received (in broken doses) from 174 to 235 c.c. of the toxic protein were inoculated intraperitoneally with doses of the living germ with the following results.

Here follows a protocol showing that the tolerant animals did bear inoculation with amounts of the living culture that killed all untreated animals.

The author continues:

That an active immunity is also developed in rabbits which have been treated with repeated injections of the toxic protein is illustrated by the following experiments:

Rabbit No. 1. Received between May 25 and July 5 eight injections of this toxic protein, the total amount of poison injected being 855 mg. On July 8 this animal received 5 c.c. of a twenty-four-hour culture of the living germ without apparent effect. The control inoculated at the same time (with the same amount of the same culture) was found dead in eight hours.

Rabbit No. 2. Received between May 28 and July 18 eleven injections of this toxic protein, the total amount of the poison given being 2,475 c.c. On July 27 this animal was inoculated with 5 c.c. of a sixteen-hour culture of the colon bacillus without effect. The control was found dead in ten hours.

Rabbit No. 3. Received between June 27 and July 18 seven injections of this poison, the total amount given being 2,475 mg. On July 27 this animal was inoculated with 6 c.c. of a twenty-hour culture. Recovered.

Rabbit No. 4. Received the same amount of poison as the preceding one. Twelve days after the last treatment this animal was given 6 c.c. of a forty-four hour culture and recovered. The control was found dead in eight hours.

From the foregoing experiments it becomes evident that animals which have been treated with the toxic protein of the colon bacillus acquire a certain degree of immunity to the living germ. We are as yet unable to state whether it is possible to obtain a high degree of immunity with the poisonous protein or not. Thus far we have had animals which have withstood inoculation with from two to four times the fatal dose of the living germ. It is worthy of note in this connection that animals which had received one injection of a non-fatal dose of this poison are able to withstand inoculation with twice the lethal dose of the living germ on the following day. The immunity which follows a single injection is, however, transitory and has usually disappeared on the second day following the treatment. This would seem to be the most marked difference between the immunity which results from a single injection of the toxic protein and that which follows a series of injections extending over a considerable interval of time. In the first instance the protection afforded is very temporary, while in the second it is still present after the lapse of from twenty-five to thirty days. It may be possible that in the case of the injections extending over a long period of time the immunity obtained is of a higher degree. This is a point which will require further study.

In the case of an animal which has been treated with poisonous protein and has subsequently received a dose of the living germ which would surely have proved fatal for a normal animal, the symptoms noticed are identical in every respect with those which follow a non-lethal dose in an untreated animal. This is a very important fact and one upon which we have laid much stress. Moreover, as can be seen from Fig. 8 [not reproduced here] the temperature curve corresponds very closely with that obtained in the case of the normal animal inoculated with a non-lethal dose of the living colon bacillus.

We see that in both instances there is no appreciable fall in body temperature until from six to eight hours after inoculation. At this time the minimum temperature has been reached in each case, and within from ten to twelve hours it has returned to normal. The similarity of the symptoms in the two instances leads us to believe that in all probability we are dealing with an immunity which is identical in character with that which is usually spoken of as natural immunity. This idea has been upheld by the fact that we have been able to obtain from egg-albumen and pepton

poisonous substances which resemble the toxic protein of the colon bacillus in their action, and by the injection of single non-fatal doses of which it is possible to obtain the same transitory immunity to the living colon germ as is observed after the injection of the colon poison. That this toxic group is common to certain bacteria and other protein bodies is not improbable, and this would furnish an explanation not only of the increased resistance to certain bacterial infections occurring in animals treated with albumen and pepton, but of some phases of natural immunity as well.

It is evident that a non-specific bacterial immunity, never reaching a degree comparable with that attainable in toxic immunity, but certainly affording protection beyond that usually present, is secured by repeated introduction of the protein poison into the body.

That his non-specific immunity should be especially effective between diseases whose causal agencies enter the body through the same tissues seems probable. However, this is a matter for speculation, and there is no scientific basis for its discussion.

Vaughan, Jr., immunized animals with the non-poisonous part of the colon bacillus and pointed out the differences in behavior of the animals immunized with the two portions on subsequent inoculation with the living culture. On this point he wrote as follows:

When we turn our attention to the symptoms which follow the injections of living cultures of the colon bacillus into animals which have been actively immunized with the split products, we find that the clinical picture differs materially according to whether they have been treated with the toxic protein or with the residue (non-poisonous split product). As has been previously mentioned, the symptoms which are observed in a pig immunized with the toxic part are apparently identical with those which one sees in a normal animal after inoculation with a non-lethal dose of the living bacillus. The picture which is obtained on inoculation of animals rendered immune by treatment with the residue is, however, quite different. In this case the animals become apparently very ill within an hour after inoculation with the living germ. Indeed, so noticeable was this fact and the treated pigs appeared so much sicker than did the controls that our first thought was that we had in some manner increased their susceptibility to subsequent infection by treatment with the residue. However, after from six to eight hours the treated animals appeared in much better condition and eventually recovered, whereas the controls invariably died.

The temperature curves in the two sets of animals vary in accordance with the above statements.

The immunity induced with the poison is non-specific; that induced with tne non-poisonous part is strictly specific. An animal treated with the residue of the colon bacillus acquires an immunity to that organism and to no other. Moreover, in order to induce immunity of this kind, one must employ the non-poisonous part of the colon bacillus. The non-poisonous portion of any other protein will not give such immunity. On the other hand, the poisonous part of any other protein induces the non-specific immunity.

Non-specific immunity is of low grade and usually suffices to protect

against only the minimum fatal dose, rarely to twice this amount. The specific immunity may protect against from two to twelve times the minimum fatal dose of the living bacillus. Both forms of bacterial immunity are low compared with the possibly high development of toxin immunity.

As we have previously stated, we believe that the scientific work, referred to above, satisfactorily explains the frequently recorded ovservations:

1. That when armies are recruited and men from all fields of life are crowded together, those from areas sparsely populated and who are unaccustomed to crowd life will prove most susceptible to infection and especially to those infections which are transferred through the respiratory organs.

2. That the man who has been long accustomed to crowd life and who has consequently frequently inhaled particulate protiens (bacteria), whether they be pathogenic or non-pathogenic, acquires a non-specific immunity, which helps him in withstanding infection.

3. That the seasoned soldier bears even newly imported infections better than his comrade who has recently joined the ranks.

In arriving at this conclusion we are not forgetful of the many minor helps at the service of the seasoned soldier, and which are unknown, unused and in many instances wholly disregarded by his undisciplined comrade. There may be, and probably is, in the seasoned man some manner of physiologic adjustment to the altered conditions under which he lives, but we are inclined, so far as his increased resistance to infection is concerned, to stress the non-specific immunity which he acquires. As has been shown by the animal experiments cited, this is easily induced, fluctuates within short periods of time, and within relatively narrow limits acts as a life saver. With this in view, let us turn back and review briefly the epidemic of influenza at Camp Shelby. The first epidemic of this disease struck the troops in this camp in April, 1918. At that time practically all the men were relatively seasoned soldiers. Out of a total strength of about 26,000, there were less than 2,000 who were affected. Still, from the fact that the remaining 24,000 were not affected by the subsequent importation of this infection in more virulent form, we believe that practically all were infected to a sufficient degree to acquire a specific immunity, but not seriously enough to induce at the time symptoms gross enough to come above the plane of clinical observations, or even to be recognized by the infected. In this way a non-specific immunity enabled this division to acquire a specific immunity which protected the men against a much more virulant influenza.

In other words, by a natural method, vaccination of large numbers was effectively secured.

We do not believe that this non-specific immunity prevents infection with a newly imported virus, but that it mitigates the effects of this infection in some instances so markedly that no symptoms are recognizable, while in others its effects are shown only in the lower death rates among those possessing it. We have seen from the animal experiments that non-specific immunity is of low grade. It protects quite securely against the minimum lethal dose of the culture, rarely against twice this amount, but beyond this it usually fails. However, this specific immunity, which the non-specific form has enabled the individual to attain, may protect against from eight to twelve times the minimum lethal dose.

It may be well to go into more detail concerning our understanding of the natural development of these two forms of immunity. In doing this we will concern ourselves especially with those diseases whose causative agents are transferred from the respiratory organs of one to the corresponding organs of another and which for the sake of brevity we have designated as "respiratory diseases."

A recruit who has never had measles comes into camp. He has escaped this disease simply because he has never been exposed to it. We make this assertion because we think that the evidence which we have presented shows that this disease when once introduced into one of our crowded camps went through it until it reached every man who had not actually had this disease. Quarantine may have delayed the progress of this disease and has undoubtedly been of benefit because it has given the susceptibles opportunity to acquire non-specific immunity, which, although it does not protect them against measles, mitigates the gravity of this disease. It makes a great difference whether our non-immune recruit is immediately exposed to measles as soon as he reaches camp (in our mobilization many men were exposed to this disease on the troop train, before they reached camp) or after months of crowd life. In the latter instance he inhales daily more or less of foreign protein which is absorbed from the mucous surfaces of the air passages and apparently digests it. In this process the protein poison is set free, the tolerance for this is increased and non-specific immunity is established. The new recruit is becoming transformed into a seasoned soldier. In this transformation he acquires no specific immunity to measles and when exposed he acquires this disease quite as promptly as he would have done as a recruit. The measles virus is apparently digested and the protein poison set free, but on account of his increased tolerance the effects are mitigated in the seasoned man. We offer a like explanation

for the well attested fact that the seasoned soldier bears influenza, pneumonia and probably many other infections better than the new man. The Typhoid Commission in 1898 found that preceding intestinal disturbances apparently gave some degree of protection against typhoid fever and wrote:

> The belief that simple gastro-intestinal disturbances predispose to typhoid fever is not supported by our investigations. As has been elsewhere stated, the members of this board began their investigations with the belief, which seems to be generally held, that acute disease of the gastro-intestinal tract render the individual more susceptible to subsequent infection with typhoid fever. However, our studies have forced us to come to the following conclusions concerning the relations between typhoid fever and preceding temporary disorders, including those diagnosed as diarrhea, enteritis, gastro-enteritis, gastro-duodenitis, intestinal catarrh, gastro-intestinal catarrh, gastric fever and simple indigestion: (*a*) The temporary gastro-intestinal disturbances of May and June had but little if any effect upon subsequent infection with typhoid fever. (*b*) The temporary gastro-intestinal disturbances of July and August instead of predisposing to typhoid fever, gave a certain degree of immunity against subsequent infection with this disease.

THE ORGANIZATION, FUNCTION AND OPERATION OF AN EVACUATION HOSPITAL

By Major ELLIOTT C. CUTLER
Medical Corps, United States Army

INTRODUCTION

(One illustration)

THE following plan for the organization, function and operation of an evacuation hospital is fairly representative of that in use by many of our units of this type in France during the campaigns of the summer and fall of 1918. It largely copies that in use by Evacuation Hospital No. 3, Lieut. Col. C. M. DeForest, Commanding, during the month of October.

The chief function of such a hospital is that of evacuation. Much hinges on a realization of this. In addition, medical care should be administered to the maximum possible without conflicting with the chief function. Professional care demands a more or less lengthy stay in hospital following operation, and it is an accepted fact that the earlier surgical intervention can be given, thereby diminishing the chances of sepsis, the greater the number of recoveries and the shorter the period of convalescence. But these units must be more or less mobile so that the number of beds available will be limited by transportation facilities. An allowance of a thousand beds will be the maximum possible in the majority of such organizations. Therefore any scheme of operation must be so planned as to hold in hospital after operation only such cases as are absolutely necessary. Here the chief function of evacuation and optimum medical care conflict. And any plan must also prepare for the maximum intake which should not exceed one thousand cases in any twenty-four-hour interval provided the General Staff has had the opportunity to make provision beforehand.

The essential parts of this plan we have adopted from an experience that admits familiarity with the organization of similar hospitals in the French and British armies as well as in our own. It is elastic, provides for the handling of a large number of patients rapidly and, under excessive pressure, for the immediate evacuation by preoperative trains of such patients as a careful examination has considered transportable under the conditions imposed. This last provision we consider to be of the greatest importance. It has been our experience, both in British and American hospitals of this type, that under severe pressure, as when the twenty-four hour intake of patients exceeds one thousand, that the usual routine plan of work has been changed in order to handle the

situation. Such last-hour shifts have invariably proven inefficient, and cases are often sent down the line without even a fresh dressing. In the following plan, provision is definitely made for just such times of excessive pressure, and we have had no fears of the ability to travel of unoperated cases which have been sent out under this arrangement. The chief factor is that all cases after admission are carefully examined and sorted by a competent person into the various channels available. Under this plan only cases requiring operation reach the operating tables, only those requiring X-ray reach the X-ray department, and all shock cases are sent at once to the shock ward. The time of the operating surgeons and the X-ray men is thus never wasted on cases that do not necessarily need their attention, and also judgment as to the future course and care of patients is rested in more competent hands than theirs. These sorting officers vary their distribution with the number of cases being admitted. Thus in times of great pressure, as during a costly advance or bitter defensive action, only the urgent cases reach the operating room, and cases which, in time of moderate activity, as fractures by rifle and machine-gun bullets without much bony destruction, retained missiles of this type and gutter wounds, etc., would be operated as soon as the few major cases were disposed of, are at once side-tracked, after being dressed, to the evacuation wards. These cases must be sent out on preoperative trains even if the base to which they will be distributed is twelve hours distant. For it must be remembered that, once a hospital of this type is 100 major cases behind, it will be almost twenty-four hours before the seven or eight teams, which was the normal allotment to such units, can operate and clean up this number of severe cases. Therefore, a preoperative train that takes even twelve hours will save the less severe cases ten hours of the interval before surgical attention could be given them in the evacuation hospital. Of course the evacuation and train authorities must understand that these cases are unoperated and that they should be routed through to the nearest available base with all possible speed. It unfortunately becomes a habit in our Medical Corps to criticise the use of preoperative trains, and their use by evacuation hospitals was with some officers taken as an indication of a lack of ability to handle large numbers of cases. It was simply an attitude due to false pride. Everything has its limitations and, when a hospital has reached its operative limit of professional care, if it can select suitable cases and get them to a hospital center long before its own surgeons could possibly find the opportunity to attend to such cases, surely it is wisdom to thus evacuate them. Preoperative trains must be recognized as a necessary and valuable part of the medical care of wounded. At times of excessive

pressure there never have been enough front-line hospitals to give immediate and full medical attention to all the wounded, and in order to do so it would be necessary to create a ridiculously large medical corps forward.

All this impresses one with the fact that one must always prepare for the maximum intake. The plans of the internal organization cannot be changed at the last minute. Every officer and man must know his job thoroughly and must be kept within a field so limited that no matter how great the number of admissions, he can still perform his duties unassisted. For one cannot count on added personnel at such times, as everyone else who might be available is also in the same predicament. This necessitates efficient and carefully planned organization if the hospital is to be of continual use when the pressure from a maximum number of admissions becomes excessive. In army activities the importance of organization is even more significant than in civil occupations because of the terrible consequences of failure in the former. And those of us who previously did not fully realize this have, in the past two years, come to a full appreciation through bitter experience. Our own experience in the Medical Corps of twenty-three months in France was sufficiently full of such lessons. As a team operator this point was not appreciated, and we were led to think that the individual effort was of considerable importance, but later, when burdened with the direction of the professional activities in an evacuation hospital, the really small value of the individual was appreciated. When one realizes that an evacuation hospital may be receiving 1,000 cases a day during a period of great activity and that an individual surgeon, if doing major cases, at best will not go above 15 cases in his twelve-hour tour of duty, the lesson is sharply demonstrated. Again, the essential and prime requisition is that only those cases earnestly requiring operation receive such attention and that the available professional skill be expended on these only. I do not believe that we are ready to accept the attitude that the lightly wounded should receive the best attention, and that, before the less hopeful cases, on the basis that they will, if immediately cared for, be available for duty in the line again in a short time.

The plan presented covers the organization of the professional work chiefly. But the question of records is also of great importance, and essential data must be collected not only for the permanent records of the Government but for a better appreciation of the case at hand and so that its subsequent care may be better directed by a thorough knowledge of its past condition and treatment. There is no refutation of the criticism of our front-line hospitals about carelessness in this matter. However, let it be said, in justice to them, that the medical staff until

the last month of the war failed to supply the forward areas with the field medical card in the necessary quantities, also that more advanced organizations, if they had them, often failed to collect the original data and send them down the line to evacuation hospitals on these cards. The improvised record begun in the evacuation hospitals was therefore usually on a poor quality of thin paper, which, however, was the only thing available, and even if pinned on, as all such records should be, was easily torn off and lost.

PERSONNEL

It is not our intention to enter into any detailed discussion in this paper of the purely administrative organization of such a unit. But so much of the success of such a unit depends upon the available surgical and medical skill that some enumeration of the necessary personnel must be given. Moreover, correct dispositions of such personnel is of prime importance. At once there is a natural division into the administrative and the professional groups. In each group will be found individuals who take almost no interest in the other group. This, however, is not wise, and all should, to some extent, understand the entire plan of organization. The purely administrative group is composed of the commanding officer, the adjutant, the mess officer, the detachment commander registrar and the supply officer or quartermaster. The enlisted personnel also should be considered as chiefly in this group, although certain of these will doubtless, because of special aptitude, always hold positions that will bring them into constant and close association with the professional group. Such will be the operating room orderlies, the X-ray, shock and preoperative ward orderlies. Roughly 250 enlisted personnel will be found necessary. The professional group should be headed by the Chief or Director of the surgical service. There may or may not be a Chief of the Medical Service. Personally I am of the opinion that two such chiefs are both unnecessary and undesirable reduplication. Evacuation hospitals should not keep medical cases one moment longer than is absolutely essential, and any medical officer, whether his training has been especially devoted to either medicine or surgery, who is of the type desirable as a surgical chief, should be able to settle best for the patient and the service how to treat and what disposition should be made of medical cases. Between fifteen and twenty medical officers should be supplied for a unit of one thousand beds. Among these there should be some with special training in eye, ear, nose and throat work. The other officers should be divided as to their special medical or surgical training about in the ratio of one (medical) to three (surgical). They should be young and active men who have graduated from a medical school within at the most eight or ten years. This type

of man will learn rapidly the new type of work and will soon adapt himself to the new life and circumstances, no matter how varied and difficult they may become. From this group must be selected officers for day and night duty in the receiving ward, the dressing tent, for walking wounded, and in the preoperative or classification ward. If an excess of medically trained officers are present, two of them can be assigned to the receiving ward. The selection of the officers to be in charge at the other two sorting points ("triages"), the dressing tent and preoperative ward must be most carefully made. As will be brought out later, the men who fill these positions must have special qualifications, and on their shoulders rests great responsibility. The remaining officers, according to their experience and reliability, are assigned to the medical wards, to a special ward for cases of injury to the head, chest and abdomen, or to the wards reserved for postoperative cases that are to be detained or for cases ready for evacuation.

Also in the professional group there must be a dental surgeon, one or two laboratory officers and two X-ray officers. Provision must always be made for day and night shifts. The nurses, too, should be considered in the professional group, and for a thousand-bed unit thirty nurses will suffice, provided all attached teams bring their own nurses with them. If it is to be the policy not to have nurses sent as a part of operating, orthopedic and shock teams, then fifty nurses should be supplied as a part of the original personnel of all such units. From this must be selected a chief nurse and night and day shifts for the operating and sterilizing room in addition to the ward work.

The last components of the professional group are the various attached teams. These fall into three classes, viz., the shock teams, the splint or orthopedic teams, and the surgical or operating teams. All three are essential for the best care of the patients, and because of the necessity of special training are best supplied as temporarily attached rather than as a part of the permanent personnel of the hospital. It is hardly necessary to point out the vastly increased ability to concentrate rapidly, at any point, a large amount of especially trained people, under this arrangement. Shock and orthopedic teams should be supplied to evacuation hospitals in duplicate if possible, one set for day and the other for night duty; in the case of shock teams duplication is essential, but one orthopedic team may suffice.

An orthopedic or splint team is composed of one officer and two trained enlisted men. These teams proved of especial use in facilitating and speeding up work in the operating room. Their duty was to keep a supply of splints ready and apply them on the cases after operation. This meant much saving of time for the surgeons and saved many a pair of

rubber gloves. Instead of breaking his asepsis entirely the surgeon turns over cases with fractures, when the operation ends, to the orthopedic team, which should apply the correct type of splint. The surgeon then changes his gloves and goes to work on the next case, which should be already anesthetized. In addition, this team keeps track of the available splinting material in the hospital, makes sure a supply is always on hand in the operating room and in the receiving ward for the exchange with the ambulances bringing in cases with a similar apparatus, and readjusts and applies splints in the wards at the time of subsequent dressings.

The shock teams are composed of an officer, a nurse, and one or two orderlies. They had been through a short but excellent course of instruction in the central laboratory at Dijon. Here they were given lectures on the theoretical nature of traumatic shock and the means of combating it, and experience in the practical technique of administering "gum" solution and performing citrated blood transfusions. These teams should be put in charge of the shock ward.

The attached surgical or operating teams constitute one of the most important groups in any such hospital. Their function is confined to the work done in the operating room. Teams should consist of an operator, an assistant (both commissioned officers), an anesthetist—who may be an officer or a nurse—a nurse and one enlisted man.

During periods of normal activity, with the division in the field, not less than ten teams should be attached. This will care for all the non-transportable and major cases provided the selection and "triage" of patients for the operating room is wisely and carefully carried out. This number of teams will accomplish between 100 and 125 cases in twenty-four hours when doing major cases only. As many as twenty teams have been attached to an evacuation hospital, but there was much confusion. However, under experienced guidance and administration, such a number of teams could be used to great advantage during periods of great stress.

Chiefs of teams should be carefully chosen. Experience during the present war has shown that the selection of men for team operators based on civilian reputation at home has been a failure. These men, necessarily those with a reputation, have often proven themselves inelastic and unable to learn rapidly, or to adapt themselves to the life and work in evacuation hospitals. Their physical endurance, also, has been insufficient. In times of pressure, in order to increase the number of available operators, teams may be split, providing an assistant has shown himself competent. It is not wise to increase teams by giving incompetent men charge of a team—far better to increase the number of

unoperated cases to be sent away by train. To keep teams on duty eighteen hours with six hours for sleep, is better than splitting a team. Men who are of the right stuff stand this easily for the short duration of a push, and men who cannot stand this should not be sent up to this type of hospital for duty. It was an unfortunate fact that the U. S. Medical Corps continued to send older men up the line because of their professional standing at home long after the other warring nations had found out that these positions were always more competently filled by younger men. This, too, is not the only reason for the failure of the older men. They apparently were unable to adapt themselves to the new conditions both of life and work. The younger men learned far more rapidly and for that reason soon were far more trustworthy. They were less infinitely better soldiers, and, no matter what corps an individual is in, he must realize that he is a soldier and subject to rigorous discipline.

GROUND PLAN AND CHOICE OF SITE

Any plan covering the professional work of such a hospital finds itself at once greatly hampered or helped by the ground plan and actual position of the various component parts of the physical structures. It is essential that the various classes, primarily medical and surgical, be grouped separately: First, because the officers in charge are different; second, for professional reasons but imperatively, because the busiest part of the hospital is that dealing with the severely wounded—roughly all the surgical cases—and all these must be grouped about the operating, X-ray, shock and preoperative wards. For the same reasons and to reduce labor and to increase the speed and the ease of handling, all litter hauls must be reduced to a minimum. And, again, if we divide the surgical cases into the litter cases and the walking wounded, the wards for the walking cases can be on the periphery of the camp and those for the surgical litter cases grouped in the center. Further still, if the roadway is so constructed as to be at the back of the evacuation wards or near them, or the hospital set up beside the mean highway with this in mind, again the litter hauls will be reduced. Those who have seen, after a week's offensive, litter-bearers too tired to work will fully appreciate the value of this. The amount of space to be allotted to each group is of importance. Otherwise, when the push comes, one may find it necessary to put a freshly operated case into a medical ward—for example, a ward with pneumonia patients. The ratio of the space to be allotted to each varies with the terrain, the time of year, the type of fighting, and many obscure influences. But these must be worked out, and even the type of men in the division in the line must be con-

sidered. Although the ground plan must always vary with the terrain, the water supply and the available permanent structures, the factors of separation of groups and of short litter hauls must always be kept in mind. The ideal evacuation hospital can better be constructed under tentage rather than by adapting it partly to buildings which may be available, because tents may be put where desired, the whole active working part of the hospital assembled in a very small area, and thus littler hauls brought to a minimum and evacuation facilities arranged for the maximum output with the least possible effort. Because of the influence each ground site will have on the ground plan to be followed, no definite design can be given which should always be followed. But the principle of grouping, and especially of the close assemblage of such structures as the receiving ward, preoperative ward, X-ray, operating, sterilizing and shock wards, must be and always can be carried into effect.

RECEPTION AND "TRIAGE"

The important functions to be performed and considered in any plan are those of admission, next of sorting, classifying and distributing the stream of patients ("triage"), and, lastly, of evacuation. Of the three functions that of the "triage" is the most important. It is the keystone of all the work and organization, and on the shoulders of the men directing this function rests the responsibility for the success of the hospital. In the plan presented there are three different points at which such sorting is done (3 "triages"), so arranged that no one place will become impossibly overcrowded. These are: (1) The receiving ward, (2) the dressing tent or ward in which the ambulatory wounded ("walkers") are cared for, and (3) the preoperative or classification ward to which all litter wounded go. The officers in the last two act as checks on the receiving officer, and, since all ambulatory cases that might be considered as necessary for operating or for evacuation on a litter are forwarded from the dressing tent to the classification ward, the officer in charge of the latter acts as a check on the second "triage." A further check is provided by the chief of the surgical service, whose advice should be obtained on all questionable cases. The plan is, after all, only a plan and, like any other, needs constant supervision and coördination. The chief of service, besides being in constant touch with all three "triages," must keep track of the evacuable cases, consider the necessity of preoperative trains, direct work in the operating rooms and shock wards, and arrange for the distribution of the more serious cases to the more experienced operating teams.

THE RECEIVING WARD (THE FIRST "TRIAGE")

All patients are admitted here. It should be close to the road and large enough to hold twenty litter cases with some benches for walking cases. Spare blankets and splints must also be kept inside and a supply of litters near by, since, for every litter case admitted, a litter and the same number of blankets covering the patient admitted, as well as a Thomas splint, if the case is admitted with this apparatus, must be returned to the ambulance bringing in the case. A table with a typewriter are necessary for recording the necessary data. There must be one officer on duty by day and one by night. This officer makes only a rough and hurried separation, and this position need not require a man of wide experience. Except for the general benefit from the presence of an officer, a noncommissioned officer could fill this position. However, if that were true, there would be frequent calls for an officer to this point, as on the admission of a case dying in the ambulance on the way down and admitted dead, or a severe hemorrhage, or a question of valuables or arguments as to the return of litters, blankets, etc.; so that, unless the number of officer personnel make it impossible, a commissioned officer should be in charge of this point. He can, in addition, speed up the litter-bearers and generally make a quicker and more reliable distribution. He must ascertain, first, if the man is wounded; if so, has he had antitetanic serum? He must also see that the proper records are taken and that the time of being wounded and the time of admission are recorded on the back of the field medical card. This allows the surgeon to calculate the interval of hours since a patient was wounded, which is often of great assistance in forming an opinion as to how best to treat the case. If the man has not had antitetanic serum, a check is made on his card, and it is administered in the dressing tent or preoperative ward, where the correctness of this finding is again verified.

There are three channels to which the receiving officer may distribute cases: (1) To the medical wards, (2) to the dressing tent for walking wounded, (3) to the preoperative or classification ward. He does, of course, help by his professional judgment, and a case that is admitted walking may be sent by him at once to the third "triage." All of us who have worked in such hospitals have frequently seen more serious cases walk in than come in on litters. In one day I picked up, among the walkers, four cases with injuries to the brachial artery and no pulse at the wrist. Such cases must be tagged for immediate attention and examination in the third "triage." Cases in shock or with tourniquets must be similarly tagged. For convenience "gassed" cases may be classed as medical, and thus an added burden removed from the few and always overworked surgical officers.

THE DRESSING TENT (THE SECOND "TRIAGE")

To this point are sent from the receiving ward all the ambulatory wounded cases except the few which the receiving officer sends direct to the preoperative ward because of emergency or the evident gravity of the injury. An officer is on duty in this ward by day and night. His duties are to examine, dress and make a record of each case. Cases which have not had antitetanic serum are given it here, and cases, which in the opinion of the officer in charge either require immediate operation or, if the pressure is great, can be evacuated but need to go as a litter case, are sent to the preoperative ward with a note in the field medical card of the opinion of this officer. The officers in charge of the dressing tent have great responsibility and should be of considerable experience. They must primarily realize that all walking wounded are not slight cases; they may require operation. Frequently large blood-vessel injuries of the arm find their way to this point, and even compound fractures of the skull may walk in. Cases that require X-ray pass to that department by way of the preoperative ward, so that the more experienced officer there may pass his opinion on the case as well. Each officer makes a note in the field medical card. This sorting point becomes, during battle periods, a very active place, and once truck loads of "walkers" begin to arrive there must be no hitch in the work here or the congestion will in a short time become confusion. However, with two nurses and two or three orderlies who have been trained, an immense number can be run through quickly, the officer passing judgment on every case. Also visiting officers, consultants, etc., can be used to most advantage here and with less disruption of the general scheme of organization.

After being dressed these cases pass to the wards reserved for this group, where a few orderlies will suffice for the policing and general guidance of the patients. Many of the patients will be found so slightly injured that they can feed and generally help their less fortunate comrades who may have arm, leg or hand wounds that render them less able to wash, dress and feed themselves. The officers who alternate on night and day duty in the dressing ward are also responsible for the future care of their patients until they are evacuated, and while the day officer is on duty the night officer must make rounds among these wards and examine any questionable case; also send back for redressing those cases needing it, or to the operating room or X-ray room cases that with time, or because of mistaken judgment, have proved non-evacuable without these procedures. Also, a case of pneumonia or other medical affection may turn up and need transfer to the medical wards, and it is essential that dysenteries and other infectious diseases be found out

early and isolated. This may frequently happen when early preoperative trains cannot be had and cases are held over twenty-four hours. During the night the day officer must make rounds for the same purpose. It must always be understood by these officers that their separation and classification is entirely elastic. Thus during periods of moderate activity the surgical chief will keep them posted as to the activity in the operating room. If only a few major cases are coming in, it may be best to devote all the energies of one operating team to just such minor cases. It has been found that an experienced team devoting all its energies to such cases, if given two tables, can run through a very large number of cases in a day, probably up to thirty-five to forty cases unless a major case turns up. However, let it always be remembered that just this danger is of frequent occurrence, and a wise surgical chief will turn over such work to one of his most experienced teams. Again, during periods of comparative quiet, practically all cases can be diverted to the operating room, and it must always be uppermost in the mind of the surgical chief that all surgical teams must be kept busy, no matter how slight the cases. He regulates the number of unoperated litter and walking cases entirely on the available amount of surgical attention his team surgeons can perform, except, of course, for those chest and shock cases as in his mind have a better chance without operation. All officers in the command must thoroughly appreciate this factor of elasticity.

THE PREOPERATIVE OR CLASSIFICATION WARD (THE THIRD "TRIAGE")

All wounded cases admitted on litters pass from the receiving ward to this point. This class of patients constitute the bulk of the work in any evacuation hospital, excepting those hospitals given over to special work, and on their care fully 80 per cent of the available professional skill is expended. This is the first point in the hospital at which the important cases are diverted into various channels. The most experienced men on the staff should be stationed here, one for day and one for night duty. They are laden with great responsibility, and on their shoulders depends, to a very large extent, the reputation of their hospital as a useful unit. They must be capable of rapid work and judgment and thoroughly able to appreciate the constantly shifting nature of the standards by which they are to judge the distribution of cases. A generous supply of nurses and orderlies must be on hand even at the cost of ward or operating room assistance, for confusion at this point means general confusion. All patients must be undressed, if possible a bath should be given, their wounds examined and dressed, and they must be distributed into the proper channels for their future care. There are five channels into which these "triage" officers may direct cases, and let it be remembered

that a mistake in judgment at this point may cost a life. To send a badly shocked case to a table for operation, to evacuate without operation a beginning gas-infection, or to let a hemorrhage or tourniquet case get lost in some special ward may mean a death. If possible, except in cases of emergency, cases should be undressed in one tent, where a bath should be given when there is time, and then taken into another tent for examination and dressing of the wounds. This avoids examining wounds in a very dirty atmosphere, as all must realize is the case in any such undressing room. When one or two hundred men have had their clothing, covered with mud, blood and parasites, removed in a tent, no matter how excellent the policing and salvaging, the conditions for examining a wound are dangerous. Of course one can easily be contented with the assumption that already the patient has had his dressing changed several times under even worse conditions, which unfortunately is often true, but that does not excuse further soiling. Naturally the most severe cases are more cautiously treated and according as their condition dictates. If critical, their clothing will not be removed until under an anesthetic on an operating table or, if they are sent to the shock ward, not until their blood pressure is rising and their improvement warrants it.

Before entering upon a discussion of the distribution of cases from this point let it be understood that, though there are five different channels into which any case may be diverted, the condition of the patient is not the prime factor deciding this issue, but that it is the number of cases to be handled. Thus a day may start out with a few admissions, all of which naturally would be diverted into the operating room. Two hours later the results of an offensive may have pushed into the hospital 500 litter cases. This results in the changing of the standard of cases for operation from all litter and perhaps the more serious walking cases, into a very restricted class composed chiefly of abdomens, sucking chest wounds and fractures of the femur by shell fragments. Before this state has been reached the surgical chief should have ordered a train for preoperative cases to be followed by one for operated and other evacuable cases.

The cases may be distributed from this preoperative ward as follows; (1) To the evacuation wards; (2) to special wards for heads, chests and abdomens; (3) to the shock ward; (4) to the X-ray ward; (5) to the operating room.

1. The evacuation wards are those reserved for patients who are to be sent away from the hospital. Into them go such postoperative cases as, after operation, are judged fit to travel without further care, always with the reservation which the pressure of a large number of cases presents. Also into these wards in quiet times an occasional clean perforat-

ing bullet wound may go or a convalescent case sent on down from field hospitals. But as the minute pressure is exerted by a large number of admissions and it is seen that the operating teams are getting hours behind the cases admitted, it becomes necessary to weed out more and more severe cases in the preoperative ward and to send them to these wards for immediate evacuation by preoperative trains—first wide-open gutter wounds, then retained bullets in addition to perforating bullet wounds, next, perhaps, fractures of smaller bones by bullets, etc., up the scale of major wounded until only cases are retained for operation of the most severe type, all others going to the evacuation wards to wait for a preoperative train.

2. Because of the gravity of wounds to the head, chest and abdomen, and for ease of handling them, it is better to set aside a special ward for wounds of this type. Both postoperative and preoperative cases are grouped together and an experienced officer put in charge. For convenience this ward should be placed next to the shock ward, but not under the same officer. We found that the true shock cases were always more than enough to use up all the time and energy of shock teams and, moreover, injuries to the head, chest and abdomen are not best treated by the methods of infusion and transfusion now used to combat traumatic shock. In addition, shock teams, though well enough trained at the base in the technique of this method, had little experience at first and could not be expected to act correctly if left to themselves. Thus, if head, chest and abdomens were put in their wards, they went ahead and transfused "gum" or blood in addition to giving heat and morphia. As a result much harm was done. To this special ward are sent direct from the preoperative "triage" injuries to the head, chest and abdomen of too severe a nature to undergo operation at that time. This requires much experience and careful judgment, particularly as regards head cases. For head cases as a rule do better, no matter how severe, if treated at once. A man with increased intracranial pressure which is probably increasing does not improve much under heat and morphia! In addition to these cases, perforating and a simple penetrating bullet wound of the chest, and cases with small retained pieces of shell in the liver, and non-sucking small chest wounds due to pieces of shell, are sent there for observation. In our experience only those chest cases that are sucking wounds or have large foreign bodies, or much bony injury, or those with transpleural diaphragm lesions gave the best result with immediate operation.

3. To the shock ward are sent all cases with a blood pressure below 100 as a fixed rule; other cases as the condition warranted. A large portion of these cases will be composed of fractures of the femur; the

majority of the other wounds will be those cases of severe and multiple injuries.

4. The majority of cases under ordinary pressure will be sent to the X-ray ward, consisting chiefly of fractures and those cases with retained foreign bodies. Here the officer in charge will write his findings on the field medical card, and then the patient goes to the operating room. Space must be provided about the X-ray ward or in it for the accumulation of cases awaiting X-ray and for those after X-ray awaiting operation. And again an officer must be provided for night and day duty. Cases of simple wounds, when found negative as to foreign bodies, if there is much pressure, go at once to the evacuation wards to await evacuation, by a preoperative train.

5. The last direction into which this "triage" officer can guide the patients is that leading to the operating room. The cases which follow this course are usually exceptional cases, for whenever possible, even if it seems probable no missile is retained, an X-ray examination should be made. Thus, in the following sequence, unusual cases are directed at once to the operating room: (*a*) Those with active hemorrhage; (*b*) Those arriving with a tourniquet in place; (*c*) Certain cases of fracture without splinting. Cases admitted with hemorrhage will have had a tourniquet applied in the receiving ward, and those admitted with a tourniquet applied will, of course, have had this constriction released to see if bleeding continues, immediately on admission. Any one of these three classes may pass to the X-ray room first. Yet there will be exceptional cases in which it will not seem advisable to waste even minutes, and the "triage" officer must realize all the possibilities beforehand.

This "triage" is certain to be a very busy point, and there are innumerable duties other than the separation and classification of cases for the officer in charge to perform. Methods of warming patients must be liberally applied, morphia must be freely used and hot drinks and a little food given if much time is to intervene before the case is to reach the operating table. A further duty is imposed by the fact that such organizations must assume responsibilities for money and any article of value which patients may bring in. It has been our experience that losses have only occurred with patients who have been anesthetized. Therefore, those cases which are to be sent to evacuation wards to wait for preoperative train need not be relieved of their valuables. They are supplied with a cotton bag (comfort bag), into which all their valuable possessions go after being undressed and their wound examined, which they carry along with them. All other patients are relieved of their valuables, which are stored in bags and kept in a

locked box. An able sergeant can care for this under the supervision of, and resting the responsibility with, the officer. The bags are ticketed, a check made on the field medical card, and later, on evacuation, the bag returned to the patient. In the case of death they are turned in to the proper authorities.

The enumeration of the above duties makes this position appear very difficult and responsible. It is, but if the work is well organized and enough assistance supplied in the way of nurses and orderlies and litter-bearers to distribute cases immediately a decision is reached, the point will not become clogged up and the rest of the hospital will be kept equally busy by an even distribution of the work to be done.

To sum up this most important part of the internal organization of the hospital, the sorting and distribution of cases, there are three points at which this work is done. (1) *The receiving ward*, where only a rough division is made into (*a*) the medical and "gassed" cases which are sent to wards, (*b*) the ambulatory wounded, and (*c*) the litter wounded; (2) *the dressing ward* for the walking wounded; (3) *the preoperative or classification ward* to which all litter wounded go. The success of the hospital pivots on the proficiency with which work is done at these points. Each point necessitates an officer for day and for night duty, and their importance increases from the receiving ward to the preoperative ward, but all these officers must thoroughly realize the elasticity of the rules by which their functions must be governed. Above all, provision must be made for a maximum intake. Attempts were made during the past summer to provide separate hospitals for non-transportables, seriously wounded and walking cases, and units were instructed as to which cases they should receive. Despite this scheme, experienced officers made provision for all three classes and when the pushes came off were prepared for what they received, a good deal of all three classes of cases. The attempt to thus specialize hospitals and group cases almost always broke down at times of pressure, probably due to the difficulties of satisfactorily sorting and "triage" at too advanced positions. To us it would seem better to keep the evacuation hospitals as general hospitals.

THE OPERATING ROOM

We have found that the French Bessonneau tent supplied to hospital organizations was admirably adapted to this function. A wooden floor, made in sections so that it can be transported and a table with one shelf running the entire length of one side of the tent, should be supplied and always carried along when the hospital moves its site. This table arranges for scrub-up basins and sterile instruments at regular intervals;

the shelf below contains the packages of sterile gauze, towels, sheets, bandages, suture material, adhesive plaster, etc.; and the space beneath suffices to hold splints. Eight or ten tables are then spaced down the room near to the side on which the table is placed, leaving about a 4-foot passageway on the other or head end of the table for use by the litter-bearers. The latter should never be allowed to pass between the sterile table and the operating tables, and they must always go one way, the evacuation and postoperative wards, if possible, being arranged near the exit. Electric lights—at least two—should be spaced over each operating table, one of them being on a long cord for examination of wounds on the lower side of patients or for better lighting of parts distant to the fixed lights. Two operating tables should be supplied to each team; this, especially in the case of minor injuries, allows a team to get through a larger number of cases than if only one table were available, as the team now and then may split into two teams where the injuries are so slight as to render an assistant unnecessary, or at least a second case may be anesthetized while the first is being finished, thus keeping skilled operators always busy. With head cases there is the added reason that the process of shaving the entire head, which should almost invariably be done, is time-consuming, and that the local anesthetic can also be given while finishing one case, thus allowing the necessary interval for the anesthesia to reach its maximum power. The assignment of teams to duty is done by the surgical chief, who also may assign certain types of cases to specially trained teams. Thus the abdomens, heads and chest usually will be better done if confined to the more experienced teams. This proved to be especially true of the injuries to the head, very few men being found well trained in this type of work. As a result of this, a more disheartening opinion than was justified was prevalent as to head cases. In competent hands they did quite as well and often presented a higher percentage of recovery than the chest and abdominal cases. Changing teams every twelve hours proved more feasible than the eight-hour tour of duty. At least one half-hour, no matter how great the pressure, must be devoted at the end of every twelve hours to a thorough cleaning of the operating room. Very strict rules are necessary in handling these operating teams. They must stop promptly and begin promptly, and they must see that their orderlies clean their portion of the operating room when their tour of duty is finished. Local rules as to the suture or non-suture of wounds and as to the conservation of gloves, ether, catgut, etc., should be posted along with the assignment of teams to duty in the operating room. It is well, too, that they be ordered to have consultations before commencing joint resection or amputation.

Surgical teams should not be given instruments or other professional equipment which renders them less mobile, causes confusion and delay in the operating room at the time of changing the night and day duty shifts, and constitutes often a grave danger of insufficient material at the active points. Sufficient material for at least ten teams should be carried by each hospital and, by thus pooling instruments, fewer are necessary for the same number of teams. We found that two sterile nurses, with all the available instruments boiled up and divided equally between them, could supply any number of teams working in a Bessonneau tent operating ward. The number of teams might run from four to eight, or even ten, depending on how many tables were allowed per team. At the time of change over of day and night teams an entirely fresh layout was always made, and as often between times as seemed advisable or an accidental break in asepsis rendered obligatory.

An orderly should be detailed as a "scribe" for each twelve-hour shift. As an operator finishes an operation he dictates a short note of his findings, and what he has done, to the "scribe," who enters the note on the field medical card. The last word of the operator's note directs the future course of that patient. He finishes with the words "evacuate" or "detain" according as to whether in his opinion the case can be safely evacuated without further care, or whether in his opinion it should remain for further care and observation in the present hospital. Of course it would be ideal to keep all cases, and during quiet times any questionable case can be held over, but as a rule the cases held over will only be those of injury to the head, chest, abdomen, most of the fractured femurs and such other wounds as seem liable to a severe infection. Cases in shock should be specially designated as such and sent at once to the shock ward, claiming precedence over all other cases when the question of available litter-bearers arises. In addition to writing the note in the field medical card, this note should be written in the operating room record book, into which the "scribe" should have already copied, during the operation, the name, number, rank, unit, calculated interval of hours from time of being wounded to time of operation, and time of being admitted to time of operation, diagnosis and the X-ray findings. The operator's name should be affixed to his note both in the field medical card and in the operating room book. The chief of the surgical service must keep his operators posted as to the pressure being exercised by the number of admissions so that more and more serious cases shall be designated "evacuate." If this is not done, the hospital will soon fill up with cases marked to be detained. Of course the chief of service in making rounds can change any of these

at will, but he will save himself additional labor by always keeping the operators posted as to conditions, and then seeing that they carry out his instructions. Also, the surgeons will be kept happier if they make the designation themselves. Someone made the remark that team surgeons were like opera singers and needed to be handled with silken gloves. This was an unfortunate truth at one time, but, with experience and the appointment of younger men as surgeons, the difficulty lapsed. Deaths on the table should have their field medical card completed and at once turned into the sick and wounded office of the unit.

For convenience the X-ray ward should be on one side of the operating room and the sterilizing room on the other. This groups essentially interdependent parts. And if a Bessonneau tent is used for the sterilizing room it will be found that there will be room for the dental and laboratory departments in the same tent. Both of these latter departments should be in close connection with the operating room, the former because the dental officer may need a surgeon's assistance if attempting reconstruction or plastic work in his chair, or a surgeon may need him to help with a case of multiple injuries, one of which involves the jaws. The officer in charge of the laboratory must be always available for taking smears and cultures and reporting on cases actually being operated upon.

THE SHOCK WARD

For this purpose also a Bessonneau tent or British army marquee tent should be used. These can be kept fairly warm and dry in inclement weather and are better suited to hospital beds which, if available, should be used in this ward. To this ward are directed from the classification ward and without operation all cases with blood pressure below 100°. In the shock ward all the means of combating what we call traumatic shock are assembled: posture, heat, morphia, fluids and gum solution or citrated blood. If administered wisely and with the help of time, a great deal of good can be accomplished. When such a case has improved, his blood pressure is rising, and as further delay means increasing infection or a lost opportunity, the surgical chief must be consulted with. If he approves, the case should be sent to the operating room, where a table will have been held vacant for him. There must be no delay once this point is reached, and such a case takes precedence over all others except those of acute hemorrhage. In addition to such cases there is also the type of case which seems strong enough to stand operation, but which, through misjudgment or, more often, a prolonged operation, as is necessary with severe multiple injuries, goes

into shock while under the anesthetic. Such cases should also be sent to the shock ward for resuscitation by the same means, or it may be necessary to transfuse the case while on the operating table. The shock team is available for this and also for transfusions on such cases in the special ward for heads, chests and abdomens as the surgical chief may direct.

The special ward for heads, chests and abdomens will contain both operated and unoperated cases and must be placed in the hands of one of the most competent officers available. As a rule, unless hopeless, the head cases should be operated as soon as possible. There has unquestionably been much confusion over this point and, at times of great pressure in some hospitals, only the slightest injuries to the head were granted space in the operating room because of a false opinion that they invariably succumbed and that, therefore, it was wasting time that could to better advantage be spent on other types of injuries. To any one conversant with General Wallace's report on abdomens, Colonel Cushing's report on heads, and Colonel Grille's report on chests, the fallacy of this opinion is evident. The fact is that it does take a special training to attempt this kind of surgery, and the adverse comment arose from the foolhardy attempt of unskillful operators attempting to work in this field. The abdominal cases as a rule must be attempted as soon as their condition warrants interference and, when it does, no time must be lost. But let it be remembered that often a perforating abdominal injury will recover without operation and in two weeks present two fistulae and a patient constantly gaining in weight and condition.

The chest cases will prove of most interest as to when to interfere. As we have already stated in our experience, immediate surgical attention is only indicated in a small group, namely: (1) Those with sucking wounds; (2) those with large bony injury; (3) those with large-sized retained foreign bodies, and (4) those with complicated diaphragm lesions. All others are sent to this ward for observation. Here they are set up, kept quiet and comfortable with morphia, and splinted by adhesive strapping as necessary. Their progress is closely watched. On indication they are aspirated and, if advisable, fluoroscoped. Positive cultures do not necessarily indicate operation. The general condition of the patient and the progress of the case must be taken into account. If those are favorable, operation is withheld, but a combination of *B. welchii* and streptococcus should, in our opinion, almost invariably be interfered with. Many, and indeed a large majority, of these cases will never need surgical intervention. Those that do need it should be carefully X-rayed. Then a thorough examination of the wounds should be carried out and a drainage opening established at the bottom of the

cavity if the original wound will not accomplish this purpose. It will be found at fluoroscopy that in many cases, if the missile were originally embedded in the lung, it has dropped down and can easily be removed from the bottom of the cavity. Cases of injury to the head, chest or abdomen should be held in the hospital for at least ten days unless very exceptional reasons interfere.

The remaining wards are: (1) Those reserved for postoperative urgical cases which are to be detained; (2) those reserved for surgical cases awaiting evacuation; and (3) the medical wards. These should be divided up amongst the medical officers according to their abilities. Medically trained men will be in charge of the medical wards, and the better surgical men in charge of the wards in which cases are to be held for observation and further dressing. Here the question comes up of the responsibility for such cases. Many operators want to dress their own cases. For the good of the whole it is best that the ward surgeon be laden with this responsibility; otherwise, there will be a tendency for the ward surgeon to neglect his work and for the operator to order post-operative cases into the operating room for dressing, when fresh cases are waiting unoperated. It is, however, best to do difficult post-operative dressings in the operating room when possible, and, if the admissions are few, the ward surgeon can order many of his more serious cases into the operating room and notify the team surgeons on duty of his action. The original operator of the case may have been on duty the previous night; if not, he will naturally dress his own case, but by no means should a case be held over until the night duty people are available for such a measure. The patient must always come first.

The ward surgeons must enter notes in the field medical card as to the subsequent progress of his cases. In addition, they have daily morning reports to make as to the number and kind of patients in their wards and how many in each group, litter or walking, medical or surgical officers or other rank, are evacuable. New lists of patients ready for evacuation must be kept. If in any ward there are both evacuable and detained cases, two sheets can be kept, one for each type, and as new cases enter the ward they are entered on the proper sheet. Officers in charge of wards must also make sure that on evacuation all patients have had their valuables returned, and they must in addition see that a hot meal is served just before the evacauation takes place.

We have not gone into a discussion at any length of the methods of keeping records, nor of the equipment of these units. It is our desire to confine this paper to the actual professional side of the organization and operation of evacuation hospitals. However, it is so difficult to find the dividing line that even these subjects must be touched upon. The equipment originally issued was fairly satisfactory. The provision of

tentage for inclement weather and special wards, as the operating ward, was insufficient, and this can best be furnished by the French Bessonneau tent. At least six of these should be supplied to each unit for use as operating, X-ray, sterilizing, shock wards and wards for the special class of head, chest and abdominal injuries. A certain number—at least ten—British marquee tents are desirable for the receiving ward, dressing tent, preoperative wards, nurses' and officers' mess and their quarters. Our United States army ward tent is unsuited to cold and rainy weather. Motors for the X-ray plant and to generate electricity should be furnished. At least two motor trucks, a small touring car and a motor bicycle, with side-car attached, are necessary for transportation. Enough instruments to supply as many operating teams as the capacity of the hospital requires should be carried, and a suitable mobile laundry is essential. For record keeping either of the following schemes may be followed. In our plan the data for forms 647 and 648 are taken on to a typewriter in the receiving ward on admission, one man reading off the information to another who works the machine. The evacuation reports are handed in by each ward at the time an evacuation occurs and the report consolidated in the sick and wounded office. Now that the reports must be arranged alphabetically, the admission data have to be rearranged at the end of each day. In the second plan a nominal list only was made on entrance and then two forms 52's were made out in the ward. One of these was returned to the sick and wounded office at once and furnished the data, after being alphabetically arranged for forms 647 and 648; the other copy was turned in when the patient was evacuated, being kept in his field medical card meanwhile, and could be easily consolidated for the report.

EVACUATION

The foregoing pages describe an organization which finally turns into special wards all cases that may be evacuated. These wards are: (1) All the walking wounded wards; (2) the evacuation wards for surgical cases, and (3) the medical wards. A daily report informs the headquarters office how many such cases are in hospital. When a train arrives, all such cases should be given a hot meal, and it should then be ascertained if they have their valuables, their records, etc. The litter litter cases usually are loaded first and the walking cases afterwards. For the smoother conduct of such evacuation it is well to have an officer and sergeant, with some assistants especially designated for such duties.

DISCUSSION

The chief function of evacuation hospitals is that of evacuation. The scheme of organization described is constructed on that assumption.

It is extremely elastic and, though planned for a maximum intake, can at any time, without any change in principle, be so modified that in the event of only a moderate number of admissions the entire available operative skill may be kept working at its maximum. Necessarily it needs constant supervision and coördination, and most of this responsibility must rest on the shoulders of the surgical chief. He must be in constant touch with all three "triages," must direct and supervise the work in the operating room, as well as consult on all serious cases in the operating room, shock ward, ward for head, chest and abdominal cases, and pass judgment on the advisability of evacuating questionable cases. Most important of all, his relations with the commanding officer must be of the most intimate and mutually trusting kind. Their work will always overlap and coincide, and they are mutually indispensable to each other. Only when the harmony between these two officers is perfect can the work done by their unit reach the maximum efficiency and usefulness. Beyond this, the establishment of friendly relations with the divisional and corps surgeons will be of advantage to all. From these officers transport and other material help may be had when necessary and also they can give warning of inpending activity. In return the evacuation hospital can furnish these chiefs with information as to how well their more advanced units are working. Thus, the arrival at the hospital of a large number of wounded who have not been given antitetanic serum, or fractured cases unsplinted could be immediately reported to divisional headquarters. It is only by this comprehensive correlation of effort that the best treatment can be given to the wounded man.

The personnel of such an institution should be composed chiefly of young men. They adapt themselves readily to the life and work in such new circumstances, they learn their new professional duties as well as their military position more rapidly, and they can stand the longer hours of work, the general physical hardships and the nervous strain without slowing up. And one must always have some reserve energy at hand in order to speed up when the exceptional push comes. From experience, we are wedded to the belief that this always does and will occur. Full provision for unforeseen events can never be made.

Although, above all, the hospital must be kept evacuated, let the condition of the individual patient be the guiding influence as to how his progress is carried out. Necessarily the scheme followed must be that which provides the most good for the greatest number, and this will in some individual instances be of serious consequence to single cases. But if the use of preoperative trains is wisely conducted, these individual errors will be less. The opinion that to send away unoperated cases was a confession of partial failure cannot be too strongly

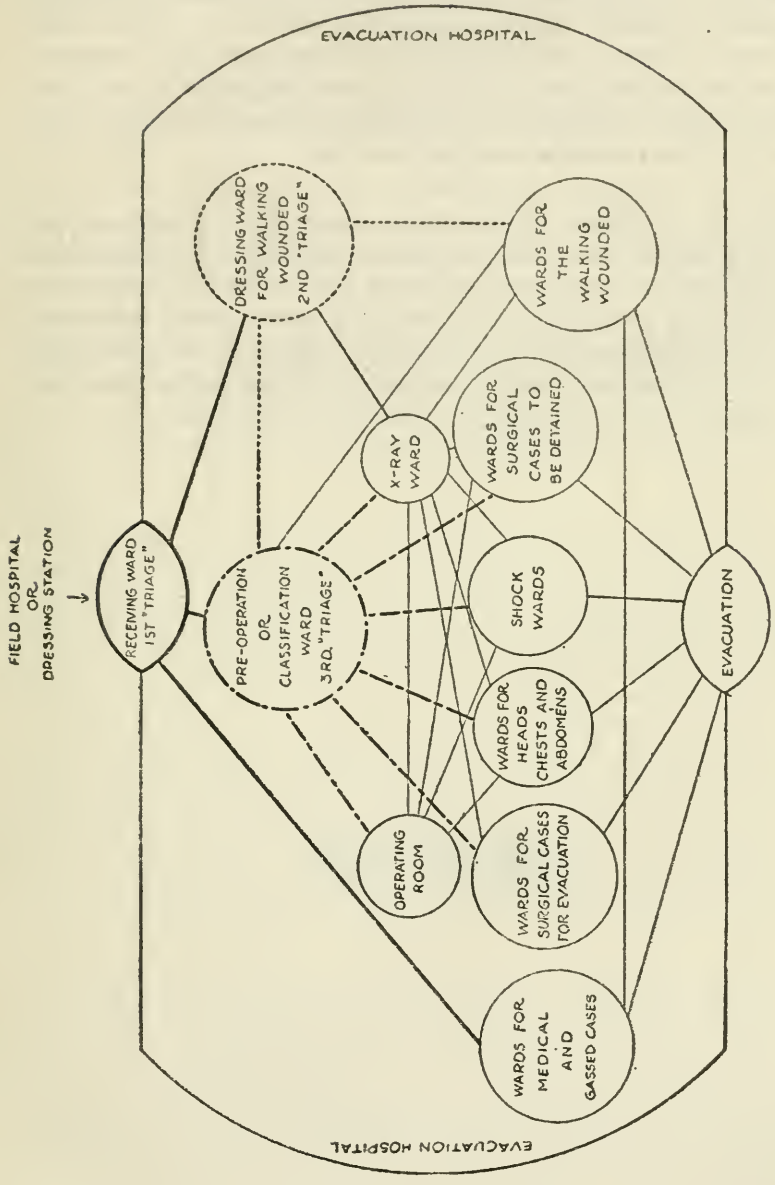

Chart showing possible course of patients in an Evacuation Hospital.

censured. In units where this opinion held, individuals were sure to be held over for operation until the interval far exceeded that which immediate evacuation to a base hospital area by such trains would have taken. The use of young and vigorous personnel, competent plans for sorting and "triage" within the hospital, and the use of pre-operative trains constitute the most imprtant elements in the success and value to the army of evacuation hospitals.

SUMMARY

This plan provides: (1) For the rapid reception of patients; (2) for the separation into essential groups, giving the best professional services to a maximum number of patients at the time most needed, the type depending on the number of available operators, the emergency of the case, and the number of cases being admitted; (3) for the compilation of all the data necessary for hospital records and for the future care of the patient; (4) for the rapid evacuation of the hospital.

PHYSICAL RECONSTRUCTION IN UNITED STATES ARMY HOSPITALS[1]

By Lieutenant Colonel HORACE M. EVANS
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THE experience of European nations who had been at war previous to the entrance of the United States into the conflict demonstrated the necessity for conserving man power. It was, therefore, necessary to adopt measures, first to restore men to military duty, or, second, to restore them to civilian life in a condition that would enable them to function to the highest degree possible. In order to accomplish these objects they inaugurated what is termed "Physical reconstruction," which was to be applied to men who had been disabled in the conflict.

Upon our entrance into the war we had the example of these foreign countries to enable us to adopt immediately a plan whereby we could conserve our man force to the best possible advantage. The Surgeon General of the United States Army established as a principle the following:

> That hereafter no member of the military service disabled in line of duty, even though not expected to return to duty, will be discharged from service until he has attained complete recovery or as complete recovery as it is to be expected that he will attain when the nature of his disability is considered. The inauguration of this continued treatment will result, during the period of the war, in the saving to the service of a large number of efficient officers and soldiers who without it would never become able to perform duty.
>
> Physical reconstruction may be defined as the completest form of medical and surgical treatment carried to the point where maximum functional restoration, mental and physical, has been secured. To secure this result the use of work, mental and manual, will be required during the convalescent period. This therapeutic measure, in addition to aiding greatly in shortening the convalescent period retains or arouses mental activities, preventing "Hospitalization," and enables the patient to be returned to service or civil life with the full realization that he can work in his handicapped state, and with habits of industry much encouraged if not firmly formed.

In order to meet these conditions there was established the Division of Physical Reconstruction of the Surgeon General's Office. This was done in August, 1917. On November 7 complete plans for the physical and mental rehabilitation of disabled soldiers, and for the reëducation of those injured so as not to be able to reënter their old occupations, were completed and forwarded by the Surgeon General to the Secretary of War. They are printed in Senate Document No. 173.

At the beginning there were several agencies making preparation

[1]Read by title at Annual Meeting of The Association held in St. Louis, Mo., Oct. 13–15. 1919.

to take care of the disabled soldiers, and in conference with these it was decided that, during the time of the hospital residence of a soldier, physical reconstruction should be under the control of the Surgeon General's Office. After his discharge he would then be cared for by the Federal Board for Vocational Education in conjunction with the Bureau of War Risk Insurance.

On July 31, 1918, authorization was given for officers and personnel to care for the physical reconstruction work in the various hospitals. In August, 1918, a definite hand-book of instructions was sent from the Surgeon General's Officer to the reconstruction hospitals approved by the Hospital Division. This outlined the organization of the Division of Physical Reconstruction which is as follows: In each hospital that is to function as a reconstruction hospital there shall be a chief educational officer who shall have entire charge of all the activities pertaining to the educational work. In addition to the educational officer there are detachment men assigned as teachers, also civilians employed in the same capacity, and reconstruction aides not only give instruction in the wards to bedside patients but in the crafts room and shops. Coördinated with the work in occupational therapy there was a section of physiotherapy, under the head of the chief, with assistants and civilian employes together with physiotherapy aides. This division makes use of hydrotherapy in its various forms, the application of electricity in every form that may be used as a curative agent and massage, togethr with special curative exercise.

TYPES OF HOSPITALS

In applying the principles of physical reconstruction it is necessary to consider at least three types of hospitals: (1) Tubercular; (2) psychiatric; (3) general.

Tubercular.—In the tubercular hospitals physiotherapy has not been utilized as a restorative agent, and I feel that we have in many cases lost the assistance of a very valuable adjunct, particularly in those types of cases in which there is joint involvement, or in other types where elimination could have been improved by means of properly applied hydrotherapy, and also in other cases where the stimulating effect of electricity could have been used to an advantage.

In these hospitals the amount and kind of work to be done was most carefully assigned and guarded, because it was found that a very intense project might so excite the patient that it would cause a rise in temperature. Therefore it was necessary in the ward work to emphasize the less purposeful and perhaps more amusing projects. Later, when the abnormal temperature has subsided, tubercular patients

furnish a splendid opportunity for initial vocational work. As they have all their limbs and faculties, they are capable of engaging in almost any kind of developmental work under the proper supervision. It was found necessary to have a larger staff in proportion to the number of patients in a tubercular hospital for the reason that the rest periods must not be interfered with, and, consequently, the hours for work were thus reduced. This, however, was not an objectionable feature in view of the fact that those who are engaged in instructing these patients should have more time for their own care than instructors in other hospitals.

One of the points that was emphasized in some tubercular hospitals was the graduated walk. This consisted in first attempting a walk of one mile. Only patients that were relatively free from abnormal temperature were permitted to engage in this walk, and the entire one mile consumed considerable time as it was arranged to have several stops on the way and frequently interesting talks upon subjects of interest were interspersed with the ordinary conversation at these rest points. Following a 1-mile walk would come the 2-mile and then the 4-mile walk, each conducted in a similar manner. The amount of good derived from these was entirely dependent upon intelligent supervision. One of the greatest benefits to be derived from these walks was that after a certain number of repetitions of a 4-mile walk a man was said to be able to do physical labor and could go into the shops, farm, school or green-house, this having a great psychological effect upon the patient.

A year's experience in these hospitals demonstrated the fact that, as a means of increasing the morale, which is a very important element in the restoration of these cases, there was no feature equal to the work done in the wards by means of the aides. This work, when properly performed, leads the man, as soon as he is able, into a more purposeful work, either in the shops or schoolrooms. Thus he is continuously encouraged and stimulated to carry on.

Psychiatric Hospitals.—The mental cases have required special study and skill in their care from the standpoint of physical reconstruction. Early in the work it was thought impossible to have any work done in what were termed "closed wards," and it was only in those cases that were less disturbed mentally that occupational therapy was introduced. After several months the aides became so skillful in their approach and development of the men that it was thought prudent to permit them to enter the "closed wards," and in these during the past months no man has been denied the assistance of these aides except those that were extremely violent, the results being most remarkable.

It is very interesting to know how even a little thing may arouse a man who has not shown interest in life or spoken a word for months, and I recall one incident. An aide had such a patient outdoors, giving him the benefit of the fresh air and a walk and trying to find some method of arousing his mental activity. At this particular time she had a tennis ball which she threw at the patient. He expressed no more interest than simply to look at the aide. She then threw the ball and hit him with it, provoking a smile. Again she threw it and struck him on the side of the face. He immediately picked up the ball and threw it at her. This resulted in a game of throwing and catching which led that patient back into a mental condition that enabled him to take up work in physical reconstruction. This simple incident has been repeated many times in various forms, so that there is no way to tell in just what manner a patient may be aroused. As far as I have been able to learn, there has not been an occasion during all these months in which a reconstruction aide has been molested or disturbed by one of these patients, even in the closed wards.

Physiotherapy in Psychiatric Hospitals.—The application of physiotherapy to mental cases was very largely confined to hydrotherapy, and this was found to be a very great advantage in a large number of cases. It is true that electricity was used in specially selected cases, both for its tonic effect and for the psychological effect. Massage was limited to special cases, but a hospital of this type should be equipped to do the work in physiotherapy.

General Hospitals.—It is in the general hospitals that physiotherapy has had its greatest work, for in these hospitals we have all the types of cases in which these agencies can be of greatest value. From the very start, in every hospital in which the equipment has been installed, the work has increased both in efficiency and in amount, until the percentage of those in the hospital receiving physiotherapy has continuously grown. The most difficult task in relation to the work in physiotherapy has been to properly coördinate the different agencies that are active in restoring a man. First, it is necessary that the ward surgeons and nurses have a proper comprehension of what can be done in the way of assisting them in their work by means of physiotherapy and mechanotherapy. It has also been difficult, even after they have known of the advantages, to secure an active coöperation. Second, it has been difficult to secure active coöperation between the physiotherapy and the occupational therapy. One important point was the fact that where a certain definite result could be obtained by means of physiotherapy, if the same results could be obtained by occupational therapy, having the man use his own effort in restoring function, it has been

difficult to have the transfer made from the passive effort of physiotherapy to the active effort of the patient himself.

THE EXTENT OF THE WORK IN PHYSIOTHERAPY

At the beginning it was thought to install equipment for physiotherapy in a few of the larger general hospitals, and that by transferring patients needing this work this could be centralized, but upon the signing of the armistice the men were returned so rapidly that it became necessary to extend this equipment not only to a great many general hospitals but to seventeen base hospitals, and we have had a staff and equipment in 48 different hospitals. The magnitude of the work can perhaps best be understood by the following summary:

REPORT OF PHYSIO-THERAPEUTIC ACTIVITIES FROM JUNE 2, 1919, TO AUGUST 18, 1919.

Week ending	*Hospital cases*	*Cases treated*	*Treatments given*	*Aides on duty*
June 2	31,958	10,046	76,495	705
June 9	31,001	9,843	79,667	715
June 16	28,861	9,758	76,805	696
June 23	29,415	9,184	77,452	676
June 30	28,985	9,341	77,215	620
July 7	28,110	8,104	56,923	592
July 14	27,010	8,247	63,038	576
July 21	24,773	7,755	65,622	536
July 28	24,386	7,242	63,835	529
August 4	23,241	7,330	61,340	524
August 11	21,472	7,365	60,270	525
August 18	20,484	7,129	58,759	525
Total			817,421	

The great number of cases and the aggregate treatments do not give a picture of the specific benefits which this work has brought in every hospital.

EXTENT OF THE WORK IN OCCUPATIONAL THERAPY

In the original plans a number of buildings for educational occupational therapy were to be erected in a few of the larger general hospitals, but it was found later that the demand was so urgent that it was not possible to construct buildings in time to meet the requirements. Therefore, additional hospitals were opened up, and seventeen base hospitals were included in the program of physical reconstruction. In these, additional hospital wards were converted into shops and schoolrooms, and ends of wards, or the verandas adjacent to the wards, were utilized as crafts rooms, and in this way the work was started without any great delay. There was more or less complete equipment in forty-eight different hospitals, and the commissioned and noncommissioned person-

nel aggregated from 50 in a 500-bed hospital to approximately 200 in a 3,000-bed hospital, with the intervening hospitals proportionately supplied. The largest number of commissioned, noncommissioned, and other personnel in the educational part of the reconstruction was 2,321. The projects in the ward work consisted of work with textiles, wood work, reed and cane and fiber work, lettering, metal work, leather, cardboard and binding, and plastic work in pottery.

The academic work consisted of practically every subject that would be found in a complete commercial course, a high-school course, and some advanced work, including special instruction in several foreign languages. The shop work included courses in electricity, machine-shop work, complete wood-working instruction and many other subjects.

The highest number of patients in hospitals functioning in reconstruction at any one time was 66,640, and the largest percentage of enrollment in proportion to the population was 38. If you take into account the fact that in every hospital there was always a large number who were critically ill, or had had recent operations, or were suffering from contagious diseses, or were away on leave, you will find that the available hospital population was approximately 60 per cent of the total, so that 38 per cent of the total enrollment was 63 per cent of the available population. The total number of individuals that had been interested in educational or crafts work during the past year was 90,000. The total number of overseas patients admitted to our hospitals up to August 22 was 161,828. It is with these patients largely that reconstruction work has had to do, as the domestic patients were not hospital residents for any great lengrh of time. The greatest number occurred during the influenza epidemic, and, of course, under such conditions were not available for reconstruction work. The aggregate number of patients in the hospitals since September 7, 1917, is approximately 1,880,449. The following table shows the analysis of the men who have been S. C. D. from reconstruction hospitals from September to June:

	Sept	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	Total	Per cent
S. C. D.—Unanalyzed...	280	226										
Hopeless	....	.....	22	8	17	14	41	13	5	15	135	.0087
Not in need further treatment	....	.....	376	505	562	1,329	4,519	2,045	2,408	2,485	14.229	.92
Unable to follow old occupation	....	.....	51	37	56	130	510	124	111	66	1,085	0.07
Total	280	226	449	550	635	1,473	5,070	2,182	2,524	2,566	15,449	

DEDUCTIONS FOR CIVIL INSTITUTIONS

The experience in United States army hospitals has demonstrated the value of physical reconstruction as a practical means of assisting in

a more speedy recovery and a more perfect restoration of function and less tedious and depressing hospital residence, so that it would be the part of wisdom for every state to establish a central institution or institutions for the care (1) of the tubercular, (2) of the psychiatric patients and (3) general hospitals to take care of every other type of disease and injury. The experience has been that the larger the population in the hospital the less the pro rata expense, and this is true in the reconstruction division as well as every other.

The amount of work that should be undertaken depends entirely upon the amount of funds that can be secured and the character of the patients to be treated. Every single individual used in a well-balanced reconstruction staff is of value, and it can be undertaken with a small number of reconstruction aides with results commensurate with the expenditure and can best be administered with a complete staff of specially trained officers and aides.

Three points are of particular value. First, to secure a director who understands the work, who is in sympathy with it, and will give it the attention in detail that a successful work requires. Second, the securing of competent teachers and aides in the educational branch. Third, the securing of a specially trained man to direct the physiotherapy, together with the requisite number of skilled aides. As a general proposition the number of personnel can be rated from 10 per cent of the hospital population down to 5 per cent, keeping in mind the fact that the larger the hospital population the smaller the percentage of personnel required, as the patients can be grouped and one aide can serve a larger number when properly grouped.

THE AIR MEDICAL SERVICE AND THE FLIGHT SURGEON

By Lieutenant Colonel L. H. BAUER and Major WILLIAM MacLAKE
Medical Corps, United States Army

TWO of the important medical developments of the war have been the establishment of a separate branch of the Surgeon General's Office to investigate and handle the medical problems peculiar to the Air Service, and the production of that specialized medical officer known as the flight surgeon.

The question naturally arises as to why there should be a special Air Medical Service, or why there should be a flight surgeon distinct from any other medical officer. In answering these questions we will make two statements and endeavor to prove them by describing the work of the flight surgeon, and how the work of the Air Medical Service in general differs from that of the Medical Department of the rest of the Army. These statements are:

1. The medical problems of aviation are new and entirely different from those of any other service.

2. The medical care of the flier can be carried out only by one with special training.

Before taking up either of these points it may be well to give the opinion of foreign medical services on this question. To quote from the *Air Service Medical*: "The British, French and Italians all stated early in the war that it is very fortunate that the air forces of the United States are profiting by the mistakes of our flying service, in recognizing at the beginning that the medical problem of aviation is a very special problem and cannot possibly be conducted except by an organized body of experts."

The advantages of a special Air Medical Service were first demonstrated by Great Britain. During the first year of the war her air casualties were caused as follows: Due to Germans, 2 per cent; due to defective planes, 8 per cent; due to physical defects of pilots, 90 per cent. They then established an independent Air Medical Service and specialized on the care of the flier. The next year the 90 per cent was reduced to 20 per cent and in the following year to 12 per cent.

When the United States entered the war it was decided to follow the advice of our allies, to select medical officers who were specialists in the branches mentioned below, and assign them to duty with the Air Service. It was discovered that we knew little or nothing about the medical problems of aviation, and in order properly to investigate these problems the Medical Research Laboratory of the Air Service was

established at Mineola, New York. The laboratory was subdivided into seven professional departments, and each department studied the problems of aviation that concerned its own particular field. These departments are physiology, cardiovascular, ophthalmology, otology, psychology, psychiatry and physics.

The most important phase of the work to attract attention was the effect of low oxygen percentage on the circulation, respiration, mental reaction and the eye. The low-pressure tank was installed, which simulated the conditions from sea level up to approximately 36,000 feet. Later a rebreathing machine was developed which will be described later. Briefly, the subject breathes over and over again the same air with the impurities eliminated. The oxygen, of course, is constantly diminished, and the result is similar to that in the tank, for it was early found that the important factor in altitude is the decrease in oxygen percentage and that the decrease in atmospheric pressure and temperature were very secondary considerations. We will speak of these machines later in connection with the classification of fliers.

The specialized work of the Air Medical Service consists of three things: (1) The selection of the flier, (2) the classification of the flier, (3) the maintenance of the flier.

Now what line is to be drawn in the selection of the flier? First of all, it was soon discovered that the standard physical examination for entrance to the Army was not sufficient. One of the most important things for a flier to have is good eyes, and by good eyes we mean not only good central vision but good central and peripheral vision, good central and peripheral color vision, good ocular muscle balance, good depth perception, proper convergence and accommodation—all of which must apply equally to both eyes. Under the stress of flying, defects of muscle balance are quickly brought out. The ordinary individual on the ground is concerned chiefly with straight-ahead vision, and a slight weakness of one or more ocular muscles is not of importance; but the flier has to look in all possible directions, particularly in combat work, and that, added to the mental strain connected with flying, together with low oxygen conditions, brings out diplopia. It takes excellent stereoscopic vision to make a landing with an airplane, and the developing of diplopia at such a time will be fatal to the machine at least, if not to the pilot. Consequently we require 20/20 vision in each eye, perfect color vision in each eye (for it has been recently discovered that because a man has excellent color vision in one eye he does not necessarily have it in the other), and his vision and color vision must be good peripherally as well as centrally. The necessity to be able to see from all directions is, of course, apparent, and the necessity of having good peripheral color vision

is particularly important in night flying because of the various colored lights that may be used around the landing field.

The question of depth perception or stereoscopic vision is important, as explained above. The old-fashioned hand-stereoscope was used originally, but this is a very poor test. It is more or less subjective, and there is a knack about it which many people with really good stereoscopic vision are unable to acquire. So a 6-meter steroscope was developed in this laboratory by Capt. H. J. Howard, and we require a depth perception of at least 30 millimeters, although experience has shown that the average man can do very much better than this.

The question of muscle balance is tested by the phorometer with the maddox rod and screen attachment. Not more than ½ degree of hyperphoria, 4 degrees of esophoria, and 2 degrees of exophoria are allowed. But the ruling on muscle balance is modified to a certain extent by the prism convergence and divergence. The pupil must be dilated and the fundus examined. Any abnormality of the fundus is a cause for rejection. Refraction of the eye must be done to detect latent hyperopia. The peripheral vision and color vision are tested by a self-registering perimeter.

All this sounds rather complicated, but we have shown, too, that any medical officer who has received intensive training in the making of this examination is able to do the work satisfactorily, and it does not require an eye specialist to make it. However, this special training is very necessary.

In the ear, nose and throat examination a normal nose and throat are insisted upon. Diseased or enlarged tonsils, or a badly deflected septum that interferes with free breathing, must be corrected. The condition of the ear drums must be healthy. Any perforation of the drum or discharging of the middle ear is a cause for rejection. Hearing must be of the 40/40 standard as tested by the watch tick, the whispered voice, and the coin test.

The question of equilibrium is a part of the otological examination. The sense of equilibrium is a most important factor in flying. A man who has not a very delicate sensing of motion is not fit to be a flier. This equilibrium test is made in the Jones-Barany chair, and the tests are made to discover the functioning of both the horizontal and vertical semicircular canals by the nystagmus, past-pointing and falling tests, and we must remember here that these tests not only give us the condition of the semicircular canals themselves but are an indication of the functioning of the pathway from the ear to the brain. Here, again, any medical officer can learn to do this test, but he must have a certain

amount of special training and experience with it before he is ready to make a reliable examination. Whenever the chair test is unsatisfactory the caloric douche test is employed in addition.

The general physical examination is similar to that adopted in the special regulations for recruiting. The question of weight, however, is somewhat different. Roughly speaking, the minimum weight is 110 and the maximum weight 170 pounds, although variations from these weights are allowed if the candidate is evidently in sound physical condition and well proportioned.

In addition, a personality study is made of each candidate, and to make this examination the examiner must be familiar with psychiatry. Here, again, it does not take a specialist to make this examination, but only one who has had special training for this particular work. Our objects in making this personality study of the aviators are:

1. To detect nervous or mental diseases which may render the aviator temporarily or permanently unfit for the service.

2. To form a definite idea as to what extent the aviator will stand the pressure on arriving at the front.

3. To determine and, as far as possible, compensate for the existence of any latent tendencies which, under the stress of actual warfare, would become so accentuated as to make him inefficient and increase his danger of nervous and mental collapse.

The vital importance of such a determination of the personality trends and potentialities is seen in the fact that, aside from the disability arising from epidemics, probably 70 per cent of the cases of lowered efficiency among the aviators is due to a break, either partial or complete, in the nervous system. This condition we term "staleness."

The early recognition of the prodromal symptoms of such staleness of the nervous system counts everything as a means of prevention of crashes with their attendant injuries, and the maintenance of a high degree of efficiency in the Air Service. This, more particularly, concerns the flight surgeon in his care of the flier.

After we have the applicants selected (and only about 70 per cent of those that can pass the army recruiting examination are able to pass the aviation examination), we then proceed to classify them. This classification is based on the information which has been discovered at this laboratory by means of the rebreathing machine. First of all the aviator is given a general physical examination, including an examination of the eye. He is also given a personality rating. The state of nervous and mental fitness of the aviator, as determined from the nervous examination and personality study, is recorded as follows:

"A." Safe, nervously and mentally fit to fly.

"B." Safe with limitations.

"C." Further investigation and special attention needed to determine and to preserve morale and efficiency.

"D." Questionable, no definite conclusion reached. Should be kept under close observation.

"E." Nervously and mentally unfit to fly.

The candidate is then given the rebreathing examination. The Henderson rebreather, which is the machine ordinarily used, consists of a steel tank with a wet spirometer at the top properly counterbalanced. The movements of the spirometer are recorded by means of a stylus on the drum of a kymograph. A Larsen respiration integrator records the volume of respiration in deciliters. On either side of the tank is a metal pipe. On the left side is the inspiratory pipe and on the right side the expiratory pipe. In the expiratory pipe is placed a cartridge of sodium hydroxide which eliminates the carbon dioxide of the expired air. There is a one-way valve in each tube which prevents the air current from going in any but the right direction. Both tubes are connected with flexible rubber tubes, which in turn are connected with the mouth-piece, the arrangement being somewhat similar to that of a gas mask. The tank is connected with a water supply, which allows flushing of the tank before and after examination, and which allows replacement of the oxygen absorbed, by water. The candidate sits in a chair in front of the tank, the mouth-piece is adjusted, and a clip placed on his nose. His left arm is free, and his systolic and diastolic blood pressures, his pulse rate, and his respiration volume are taken by observers every three minutes during the first fifteen minutes of the test and every minute thereafter. A clinician stands by and examines his heart at frequent intervals.

The effect of the low oxygen on his efficiency is determined by a psychological apparatus which is placed before him. This consists of a table on which are installed two rows of electric lights which are turned on individually in an irregular order at regular intervals, remaining lighted for two seconds. There are two rows of washers and screw-heads below the lights, one corresponding in position to each light. By means of a stylus the candidate must touch the screw-head corresponding to the light which flashes and must touch it before the light goes out. In addition there is an ammeter which is controlled by a rheostat under his hand which he must keep constantly at the same point, and this he does by moving the rheostat in the direction in which he wants the needle to move. Third, there is a motor with both high and low speed, which he is required to keep at low speed. The difference in speed is told by the intensity of the sound, a low-pitched sound indicating low speed and a

high-pitched sound indicating high speed. This is controlled by a foot pedal which he depresses either with his toe or heel to change the speed. The psychologist sits opposite him and controls the ammeter and the motor. The lights are worked by an automatic flasher. The candidate thus has three things to attend to: First in importance, the lights; second, the ammeter; and the third, the motor. Particular note is made of the early effects on attention and motor coördination. When he reaches the equivalent of high altitude he begins to feel the want of oxygen. He responds in the ideal way by an increase in volume of respiration and by an increase in the pulse rate. In some cases there is also an increase in systolic blood pressure, but in the ideal case this does not occur, or at least not until the very end. His mental reactions become more sluggish. He begins to neglect first his motor, second the ammeter, and third the lights. Finally he becomes absolutely inefficient and is taken off the machine. After two or three big breaths he is practically normal again and many times asks why he was taken off, not realizing that he has been doing anything out of the way. The candidate frequently reaches what amounts to unconsciousness, without realizing it, and this is an unconsciousness of the nervous system *only*, as the circulation holds good. Of course, if he were kept on the machine, eventually his circulation would break. He may react in other ways. He may be taken off because he develops a heart murmur, because of an impending break in the blood pressure, or a fluttering pulse, but the great majority are taken off by the psychologist because of mental inefficiency. At the end of the run the air in the tank is analyzed to determine the exact percentage of oxygen. The man is then graded according to the action of his blood pressure, his pulse, his respiration volume, and according to his psychological reaction and the percentage of oxygen which he attained—in other words, according to the way he adapts himself to high altitude (psychologically) and according to the strain on this circulatory system.

The men are graded into four classes, and these classes are determined by the needs of the service. Class D are grounded, they being totally unfit to fly. Class C are allowed to fly up to 10,000 feet. This class usually shows some circulatory strain. Class B are allowed to fly up to 15,000 feet, and Class A to any altitude.

Combat work is done at a very high altitude, day bombing at moderate altitude, night bombing and and reconnaissance at a low altitude so that these classifications meet the needs of the service. Of the A, B, and C classes, about 61 per cent are graded A, 25 per cent B, and 14 per cent C. So by these methods we are able to determine, before a flier ever leaves the ground, the altitude to which he may fly safely.

Let us quote an example of a flier out of condition. One flier at this field came here for a classification examination. He was rated Class "C." He made a very poor run. It developed that he had just recovered from an attack of influenza and was in a very run-down condition. He was ordered away on a month's sick leave and on his return was examined again. This time he received an "A" rating. If you put a flier on the rebreather who has been out half the previous night, he will make a distinctly poorer run than he will make after a night's rest. Fliers do not appreciate these things by themselves. They must be made to consider them.

Now we have our flier selected and classified for the work which he is to do. We are somewhat in the position of the man who has bought an automobile. The latter has his machine but, unless he takes care of it, it will soon cease to run. The same is true of the flier. The flier must be maintained in at least the class in which he was rated at his entrance to the service and, if possible, improved.

The aviator is subject to certain conditions to which the ordinary individual is not subject. While in the air he is subject to the effect of low oxygen. Furthermore, there is a mental strain while flying which eventually wears a man down. Then, too, the aviator is somewhat similar to an athlete. So long as the athlete trains a certain amount with proper recreation he can go for a long period, but if he is too intensively trained he becomes stale. Probably this analogy is not a good one, for an athlete becomes stale because of over-exertion physically, while the aviator becomes stale, not because of the physical work which he has done but because of the severe mental and nervous strain which he has been under. The nature of his work causes functional degeneration of his mental and nervous system. After prolonged flying without rest the aviator begins to do things which are unusual for him. He makes a bad landing. Perhaps he has a crash, and he begins to be afraid to go into the air. In fact, he may completely lose his nerve. If this keeps on, he will eventually become absolutely worthless as a flier.

The maintenance of the flier calls for the flight surgeon. He is a man who specializes in the care of the flier and is himself a flier. We may quote here the official statement of the flight surgeon's duties:

The duty of the flight surgeon is to act as adviser to the commanding officer of flying schools and squadron groups. Although under the post surgeon, he has freedom of independent initiative in all questions of flying fitness of aviators or cadets. Subject to the approval of the commanding officer, he is expected to institute such measures as periods of rest, recreation, and temporary excuse from duty as may seem to him advisable. He takes sick call for aviators and cadets and recommends a disposition of cases excused from duty. He will visit such cases as may be in the hospital at the post and consult with the attending surgeon or physician regarding them.

From time to time he will make routine reëxaminations of aviators and cadets, also such special examinations as he may deem advisable, being assisted therein by data furnished by the Medical Research Laboratory. He will live in as close touch with the fliers and cadets at his station as is consistent with the conditions.

Thus the aviators meet him on the flying field, at mess, in quarters, and during their recreation time. He is one of them, a flier as well as a "medico," and, while having the finest opportunity for observing them, soon becomes their confidant and adviser. The post-surgeon never sees them unless they are physically incapacitated and report at the hospital—this is usually too late so far as maintaining the highest efficiency of the aviator is concerned. Thus we see that, no matter how well qualified as a medical officer the post-surgeon may be, he cannot fill the place of the specially trained flight surgeon.

The flight surgeon should be in close touch with the commanding officer of the flying field and with the officer in charge of flying and the stage commanders, to be ready to advise them on all occasions, go around from day to day and inquire from them whether any particular man is doing anything unusual. If they tell him that a certain flier has been making bad landings for the last week, there is probably some reason for it which he can detect. He can make himself the most valuable man on the flying field, without exception, if he appreciates the possibilities of his position. On the other hand, he must remember that there will always be a few who will be invariably trying to get out of some unpleasant duty or to obtain sick leave. In granting sick leaves he must be cautious. The responsibility is his if he sends a man into the air who complains of being ill and who has an accident. On the other hand, it does not speak for efficiency if he grounds every man who comes to him at sick call. Thus the flight surgeon, by examinations and personality studies of his fliers, will prevent accidents.

Now a few more words as to the Medical Research Laboratory. Its duties can be divided intothree groups: (1) Research; (2) routine classification of fliers; (3) instruction of flight surgeons. Under (1) all medical problems of aviation are considered. To mention only a few of the subjects which have been investigated—the effects of low oxygen on the circulation and respiration from all standpoints, the reaction time of aviators at various altitudes, improvements of methods of examination and classification, dark adaptation, effect of tobacco on vision, the effect of altitude on the size of the aviator's heart, the effect of various diseases on the internal ear, the speed of accommodation, the judgment of distances, the effect of "stunting" on the internal ear, development of proper aviation goggles, investigation of the oxygen supply apparatuses, and numerous other points.

To quote again from the Air Service Medical:

The greatest usefulness of the knowledge that "stunting" is an ear problem lies in the fact that the flier may be educated to disregard the vertigo effects of his stunts in the laboratory instead of among the clouds, and, without danger, acquire a tolerance to evolutions to a degree impossible in the air. This can be accomplished by the use of an otologic apparatus known as the orientator. In its construction it is like the cockpit of an aeroplane suspended in concentric rings after the manner of a ship's compass. The movements (or changes of position) which are possible in all directions except actual forward progression are governed by the individual seated in the machine using a set of controls resembling those of an aeroplane. Strapped in this machine he is enabled to execute any evolution. such as the loop, spiral, etc., at any desired rate of speed for any number of turns and thus acquire in absolute safety a tolerance for the disturbing effects of vertigo induced by these evolutions instead of acquiring this tolerance and knowledge by actual flying with its consequent crashes and possible loss of life. In addition, it will enable him to adapt himself to new and most unusual conditions.

A good deal of criticism has been directed against the orientator due to a misconception of its use. The idea has become prevalent that the orientator was intended to teach a man to fly. This is not the fact. A man will never learn to fly in an orientator. Nearly every flier with whom we have talked, who was opposed to the orientator, has shown on questioning that he entirely misinterpreted the idea of the machine. In each case where we have been able to talk to him at length and persuade him to try out the machine himself he has become a convert to its use.

"The orientator placed in the ground and flying schools will save many lives and machines, shorten materially the time of flying instruction, and develop a large number of stunt fliers."

Such an orientator is installed at the Research Laboratory. Its relation to vertigo is being studied. and it is hoped in connection with advice of practical fliers to develop a system of training for men just learning to fly.

The effects of rapid orientation upon the circulation are also to be studied. This machine, it is believed, will prove not only an apparatus for training but also one for research.

The examination and classification of aviators have already been covered in this paper.

Under (3) a school of instruction is conducted here to train flight surgeons in their duties. This training consists in lectures, demonstrations and practical work in normal physiology of respiration and circulation, and in the physiology of respiration and circulation of the aviator—lectures, demonstrations, X-ray interpretations, and clinical work on the heart. The ability to differentiate the arrhythmias and all types of valvular diseases is insisted upon. The effects of aviation on

the heart are also taken up. The ability to make a careful nose and throat examination and to perform the equilibrium tests is also required. Lectures and practical work on the normal eye are given, and the ability to make a complete eye examination of the prospective aviator is necessary.

In psychiatry, the general field is covered by lectures and clinical work, and special attention is devoted to the making of personality studies. In psychology, elementary statistical methods, elementary psychological methods, and the psychology of aviation are covered. In physics, the consideration of oxygen supply apparatus, aviators' goggles, etc., is taken up. The course covers two months of intensive work.

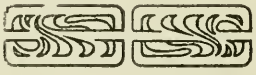
We have endeavored to prove in this paper that the care of the flier is not so simple as it might seem on the surface. It is not an exaggeration, in our opinion, to state that the ordinary medical officer is totally unprepared to care for the flier or even to appreciate the medical problems of aviation without special training.

The longer a man is with the Air Service the more valuable he becomes. and the constant shifting of men from one branch of the service to another will not speak for efficiency. He should, therefore, not be transferred for other duty without very good reasons.

As the result of the experience of foreign armies, when we entered the war it was decided to start a special medical service for the Air Service. It is directed by a chief surgeon, whose functions combine those of a department surgeon and those connected with the special medical activities of the Air Service. Other officers are detailed to the Air Service and carried as unavailable for the rest of the service. This is as it should be; but it would be far better if these men could be considered as permanently unavailable for other duty rather than unavailable merely for the time being.

The research work of the Medical Research Laboratory can be carried on only by specialists. It will be far better for the Air Service if these men can be kept at their special work. It will not speak for efficiency if a research ophthalmologist or a physiologist who is thoroughly familiar with the air service work, and who perhaps understands the research end of it better than any one else, is called away from his specialty for general medical work or for foreign service or any other duty. It will be impossible to build up an efficient corps of experts unless, when once detailed to the work, they are detailed to it permanently. This, of course does not apply to everybody in the Air Service. Men doing the routine, hospital and sanitary work of an air service post can be transferred from one place to another, or at least from one air service station to another, and the flight surgeon can be transferred from

one air service post to another, although this latter should not happen too often because once a flight surgeon knows the men at his station and wins their confidence it is some time before a new man can reach the point in the work at which the former flight surgeon stopped. There is a tendency recently in the Army Medical Corps, once a man shows a peculiar fitness for laboratory duty or for surgery or for any other specialty, to keep him at that work more or less constantly, although of course he may have changes of station. The same should apply to the Air Service. Once a man demonstrates his ability in the air medical work he should be kept at it and not transferred to another variety of duty.



BRITISH AMBULANCE TRAINS[1]

By Captain F. L. PLEADWELL

Medical Corps, United States Navy

(With eleven illustrations)

THESE notes on the subject of ambulance trains are based upon a number of inspections of both military and naval trains, in England and France, and upon extended observations made during two trips in a naval ambulance train[2] and one in a military train, actually engaged in transporting sick and wounded, as follows:

28 May, 1916: Inspection of Military Ambulance Train, London. (Great Eastern Railway.)

15–18 June, 1916: Trip on Naval Ambulance Train No. 3. (London-Plymouth-Gosport-Chatham.)

19 June, 1916: Inspection of Military Ambulance Train. (Waterloo Station, London.)

10–11 July, 1916: Inspection of Reserve Military Ambulance Trains. (Southampton Docks.)

19 July, 1916: Inspection of Naval Ambulance Train No. 4. (Edinburgh.)

6–7 September, 1916: Trip on Naval Ambulance Train No. 3. (Craigentinny, Scotland to Portland, England.)

7 October, 1916: Trip on Military Ambulance Train. (Dover to London.)

HISTORICAL DATA

The value of railways as a means of transporting troops and furnishing supplies has long been conceded, but these advantages are not greater than those of rapidly and safely evacuating the wounded from an army area. The war in Italy in 1859 demonstrated the value of railways to warfare, although only an imperfect organization had then been attained, and no organized ambulance train service was available in that campaign. In our Civil War there was instituted a Railway Hospital Service which provided for the rapid conveyance of sick and wounded to the rear. This service, however, came rather late in the war and did not reach a very high state of development. What was then accomplished, however, served to pave the way for further advance by Germany in the War of 1870. In that war elaborate arrangements were made for removal of the disabled by ambulance trains. These trains distributed the wounded to the various hospitals in Germany. As

[1] Read at the annual meeting of the Association of Military Surgeons held at St. Louis, Mo., October 13, 14, and 15, 1919.

[2] This naval train has been described in an article contributed to the *Naval Medical Bulletin* for October, 1919.

soon as an army corps moved forward the wounded were transferred to the *Feld-Lazaret*, and every man who could be moved was taken to the nearest railway station, where he was placed in a train. The seriously wounded were moved from the train to hospitals situated in the towns nearest the frontier and their places filled with men who had previously been placed in these hospitals and whose wounds were healed to a degree permitting them to move on, and thus the wounded were transferred step by step from the battlefield to their homes. This system produced a favorable effect on the morale of the men, for any soldier knew when he went into battle that, if wounded, he would be conveyed home to be tended by his own people. This system largely eliminated the necessity for the field hospital, but it had some drawbacks. It presupposed the maintenance of a safe and regular railway communication between the army operations on foreign soil and the home country, but if lines of communication are severed, this system fails. After the striking object lesson of the Franco-Prussian War, a highly organized ambulance train service was included in the military organizations of the principal powers. Permanent hospital trains on the Continent were constructed so as to contain kitchen, pharmacy, storeroom, and wards for the wounded belonging to the lying-down category. Through-and-through corridor communication was afforded. In Germany they were known as *Lazaret-Züge*, in France as *Trains Sanitaires Permanents*, in Austria as *Sanitäts Züge*, and in Italy as *Treni-Ospedali*. The establishment for an army corps varied considerably in the different countries, and the carrying capacity of trains also varied. British trains were first used in the South African War. In the recent war they reached a high state of perfection in organization and administration and contributed materially to the successful evacuation of wounded. Railway companies showed a commendable zeal in affording the War Office and admiralty officials every facility for providing these trains promptly and in making all necessary alterations to conform to the special uses for which they were to be employed. Generally speaking, all the trains provided by the several British companies were of uniform design, the vehicles being produced by a conversion of ordinary rolling stock, taken from main line traffic and altered to suit required conditions. A train has been turned out in ten days, and a naval train was actually finished in thirty hours. In instances like these, of course, existing material was utilized. Immediately upon receipt of a request from the War Office or Admiralty for a train, suitable vehicles were withdrawn from traffic and brought to the carriage shops, where necessary alterations were put in hand. This work of conversion and equipment was expeditiously performed.

Two trains were made ready for service by the Great Western Railway, by August 14, 1914, ten days after the declaration of war.

Trains were operated both in home territory and on the Continent, and at least twenty-eight military trains and four naval trains were required in home territory for carriage of wounded from ports at which hospital ships evacuated wounded to hospitals in England and Scotland. The vehicles comprising these trains were made up of connected vestibule carriages of the latest type. Each train was provided with a pharmacy, treatment room, linen rooms, office, storeroom, kitchen, cooking appliances, hot and cold water arrangements, mess compartments and dining coach, and pantries and ward cars for officers and enlisted men. Some trains were provided with an operating room and some with a padded cell for mental cases. The order in which the cars or coaches composing a train was marshalled varied with different trains, but in general the central vehicles were designed to accommodate patients, those at either end being for the convenience of the staff and for stores. In military trains a pharmacy and treatment coach was placed between the ward cars. The detailed arrangements of some of the principal coaches of a typical train are shown in Fig. 1.

Some trains were arranged with cots in two tiers, and some with cots in three tiers. Ward cars arranged for lying-down cases are shown in Figs. 2 and 3.

Two methods were used of conveying lying-down cases in ambulance trains—the fixed bed and the movable cot, the former being exclusively used in all military trains. The naval ambulance trains had no fixed cots, using an ordinary service canvas cot stretched over a wooden frame holding a mattress, the whole being suspended from hooks in the roof of the coach and interchangeable. In some of the military trains the cots were interchangeable and could be used as stretchers, but they were not so employed to any extent. Where the cots are in three tiers, a coach will hold 36 patients when arranged for all patients to lie down, and 48 when arranged partly for sitting-up cases. Coaches with two tiers of cots accommodate 24 patients. The arrangement for sitting-up cases is made by removing the middle tier of cots, placing them at the back of the bottom tier, and taking the mattresses from the top tier and arranging them in the bottom tier to form couches on which the less serious cases can be accommodated. (See Figs. 4 and 5.)

Ample space was provided between cots to enable stretcher-bearers and attendants to pass, as to the operating room, and, when extra room was required, such as in loading up cots or cleaning under or about them, they were slung up against the sides of the vehicle. Each cot had woven wire springs, a mattress, and was hinged to the wall of the coach. Nu-

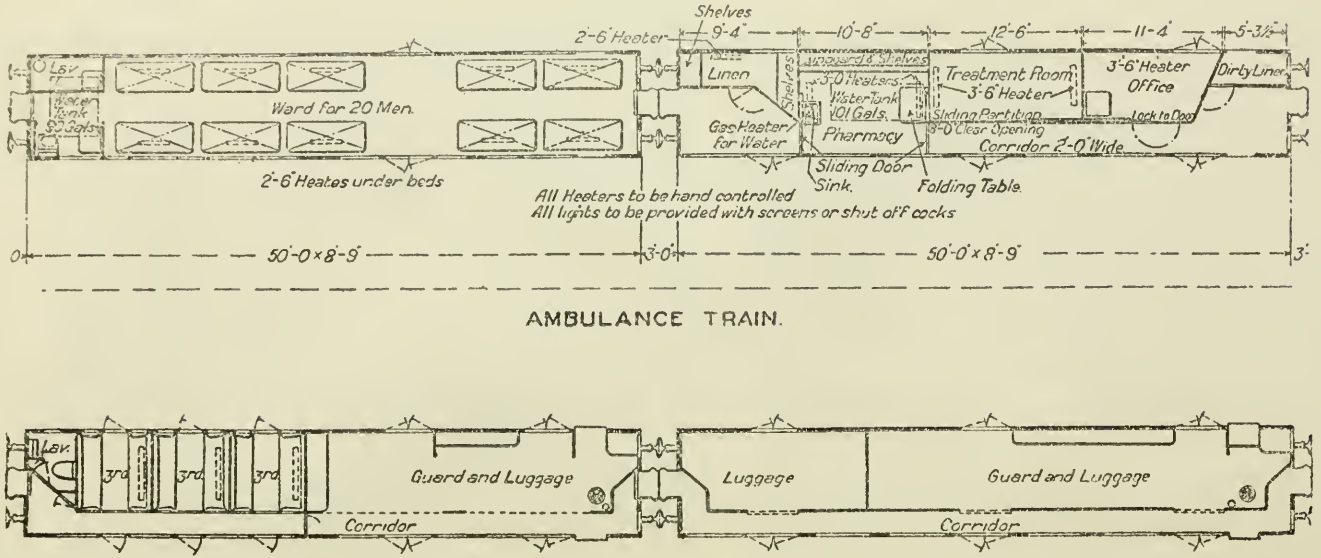


Fig. I. Details of Great Eastern Railway Ambulance Train. (Railway Gazette)

merous types of cots were in use, and the details of some of the more commonly used may be seen in the illustrations. Access to and egress from the coaches was made easy by wide side openings arranged with sliding or folding doors. (Fig. 6.)

Trains were fitted throughout with electric bell communication, and some with telephone service between certain sections of the train. Some trains were lighted by incandescent gas lights, but many by electricity, the current being supplied from equipment of storage batteries fixed under the vehicle. The capacity of the batteries was such that they could supply light continuously for approximately twenty-four hours, even though the coach was standing still the whole of that time. When the train was running the lights were supplied with current direct from the generator, which was driven by means of a belt attached to one of the axles in each coach. By an ingenious arrangement of switches the lights could be varied at the wish of the attendants. For example, each of the ward cars was fitted with five fixtures contining two lights each, which might all be switched on, or so that there was one light in each fixture, or that the middle fixture only was lighted. Again, in each of the sleeping compartments for the doctors, nurses, sitting-up cases and attendants, the lights could be switched on full or dull, in the latter case there being merely a glimmer of light. Lights in the wards were fitted with green baize covers for the purpose of obscuring the lights when necessary. Those in the staff rooms were each controlled by a separate switch. The lamps in treatment rooms were generally of 25 c.p. and arranged to cause no shadows. Portable hand lamps were provided here and in the wards. Emergency lighting by lantern was also provided. Fire appliances and fire extinguishers were part of the equipment. Heating was by steam from the locomotive, or, when cut off, by steam or hot water from a boiler placed in a compartment in one of the coaches. Individual heaters were placed horizontally beneath the lower cots, controlled either collectively or singly. In the naval trains the steam radiator piping was run overhead the length of the train. In addition to steam heating in some trains, both the staff and personnel coaches often had a self-contained system of heating for use when the vehicles were standing without an engine. This arrangement comprised a series of hot-water pipes running the length of the vehicle above the beds and heated from a coal-burning stove placed in one corner at the end of the corridor. In connection with the heating system, a tank is fitted holding about 10 gallons of water, through which the heated pipes pass, and this provides a supply of hot water when the heating apparatus is in use. The floors of cars were coved at all angles and covered with linoleum turned up at the sides to prevent dust collecting in the skirting, the corners being filled

with fillets for the same purpose. The floors of lavatories, operating, and treatment rooms were lined with lead to the height of about 3 feet and provided with drain holes so that they could be thoroughly flushed out. The treatment room in some trains had the walls above the lead lined with aluminum. The lavatories had a patent combination consisting of a water-sealed w.c. pan and water waste preventer. During short stoppages in stations lavatories were locked, but when a train had to stand some hours at stations or sidings outside closets had either to be used or buckets with dry earth and disinfectant placed under the w.c. pipes. Trains were fitted with dual brakes, vacuum and Westinghouse, with automatic communication throughout, to enable them to travel, if required, over any railway in Great Britain. Trains for the continent were fitted with coupling-up equipment for connecting to continental locomotives.

Electric fans were provided, and in ward cars they were disposed as follows: One fixed at each end of the car and one depending from the ceiling in the center so that a constant circulation of air was maintained throughout the ward, while portable fans were provided for use with cases of gas poisoning. The interior of cars was usually painted with water-resisting enamel white, which gave a light and clean appearance and permitted of the interior of the car being easily cleaned. In each of the vehicles a 6-gallon, securely locked tank was provided for drinking water. The character of the trains was indicated by a red cross on a white ground on each side of every coach, and in some trains a similar cross was painted on the roof so as to be observable from aircraft.

The utensils and general medical and surgical equipment of trains were supplied from the War Office or the Admiralty, ordinary train equipment being supplied by the railway company.

Ventilation was provided for by torpedo ventilators in the roof and sliding panels over each side light, giving a clear opening to the outside.

The general water supply of a train was contained in gravity tanks, independent of the water tanks for special purposes like drinking water, or for the pharmacy or kitchen. In a sixteen-vehicle train the total water supply ran from 1,800 to 2,353 gallons.

The pharmacy car contained the pharmacy, treatment room, office, stores for clean linen, etc., and a bin for dirty linen. It was fitted with cupboards, nests of pigeon-holes and shelves and racks for holding bandages, medicine, and surgical necessities, and a special rack for bottles. An earthenware sink was placed in this compartment for washing utensils. Above the sink in some trains is placed a 2-gallon urn, heated either by a "Primus" stove or by gas, for supplying hot water. This compartment was provided with a sliding door. Next to the phar-

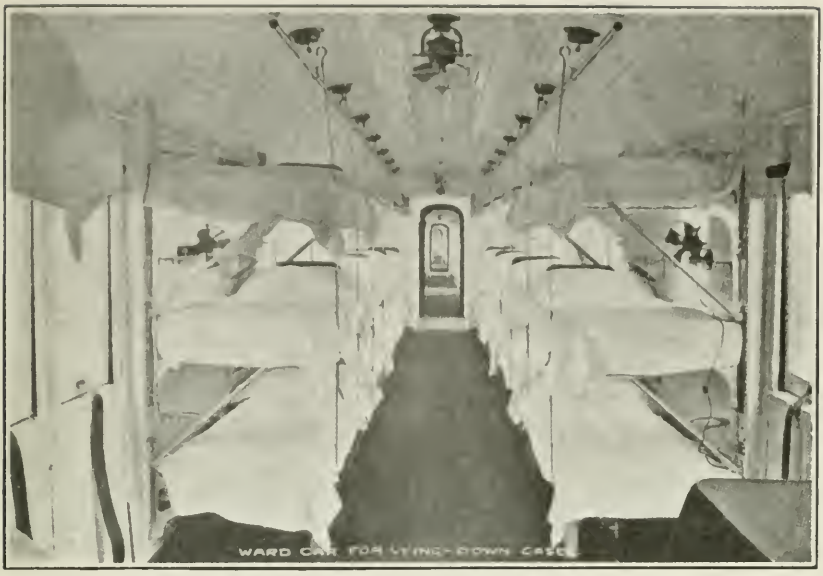


Fig. 2. Ward Car for Lying-down Cases. (*Railway Gazette.*)

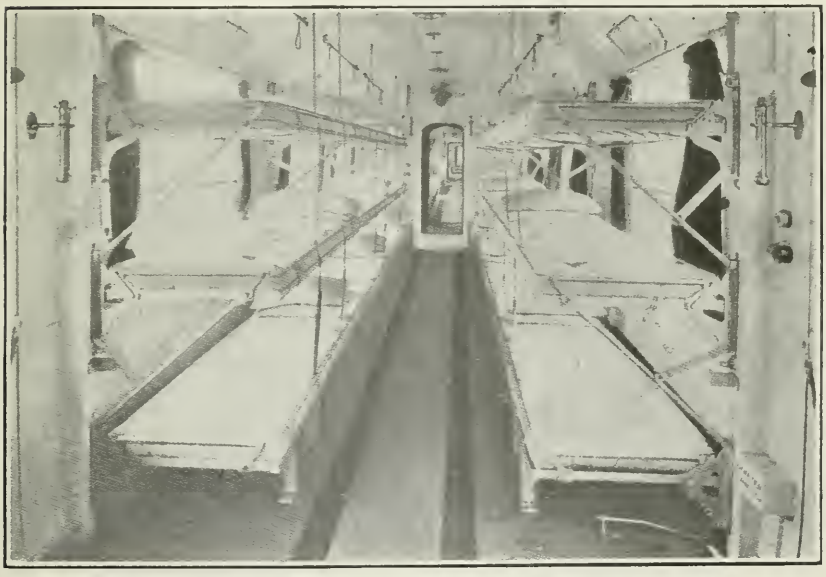


Fig. 3. Ward Car Arranged for Lying-down Cases. (*Railway Gazette.*)

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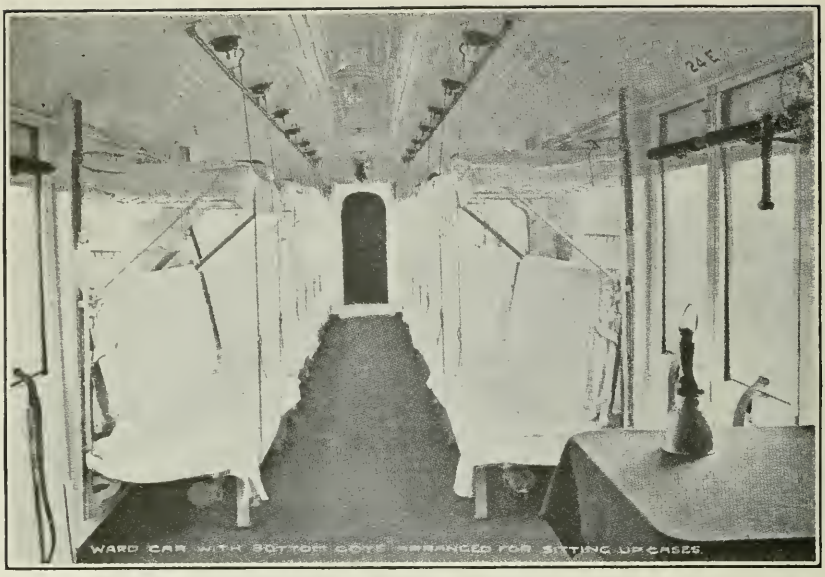

Fig. 4. Ward Car with Bottom Cots Arranged for Sitting-up Cases. (*Railway Gazette.*)

Fig. 5. Ward Car with Cots Folded up and Two Bottom Cots Ready for Stretcher Use. (*Railway Gazette.*)

Fig. 6. Great Western Railway Ambulance Train. Method of Loading Wounded Men. (*Railway Gazette.*)

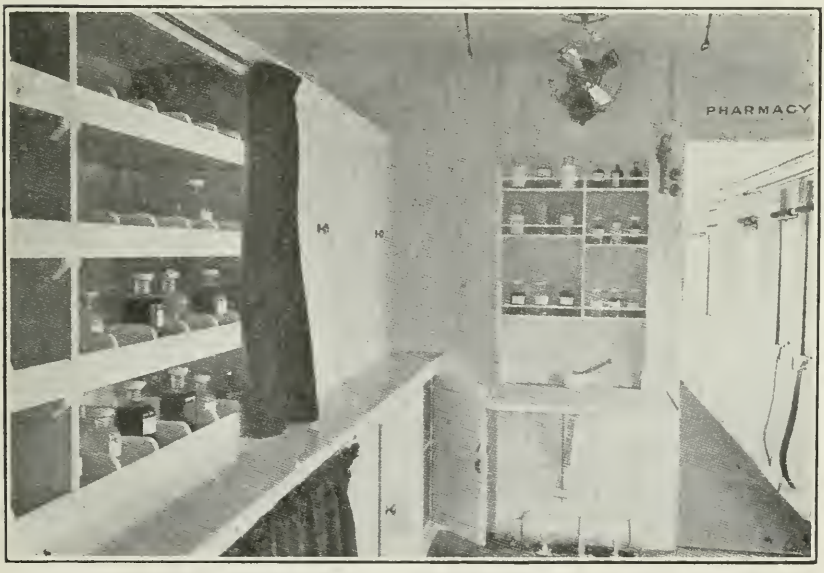

Fig. 7. Pharmacy Car (*Railway Gazette.*)

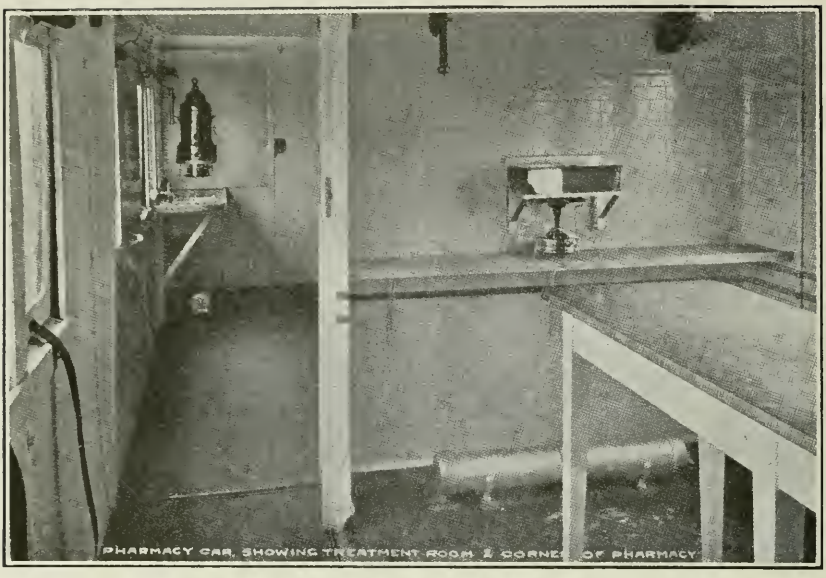

Fig. 8. Pharmacy Car, Showing Treatment Room. (*Railway Gazette.*)

Fig. 9. Pharmacy Car Office (*Railway Gazette*).

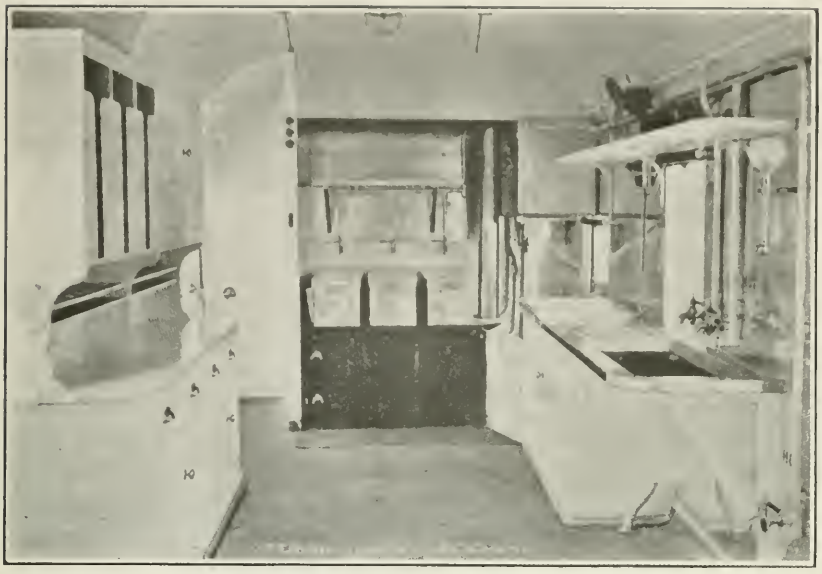

Fig. 10. Interior of Kitchens (*Railway Gazette*).

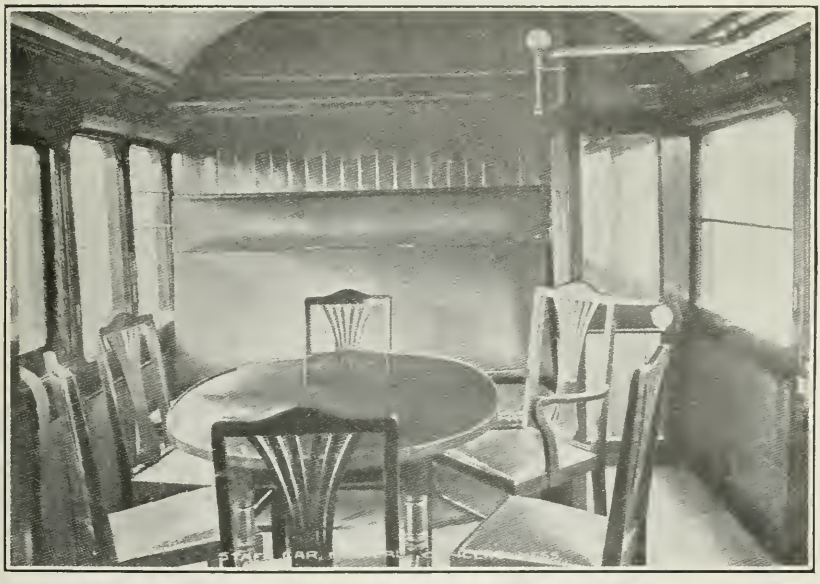

Fig. 11. Staff Car. Medical Officers' Mess. (*Railway Gazette.*)

macy was the treatment room, which was provided with a bench for patients and with special doors to allow of a stretcher being brought in from either end of the train. A sterilizer for instruments was heated by a "Primus" lamp or by gas. The floor and sides of this room were lined by lead or zinc with drain holes in the floor. (See Figs. 7 and 8.)

The office was fitted with a desk, safe, lockers and cupboards, chairs, and in some trains a typewriter arranged on a disappearing platform was provided. (Fig. 9.)

The kitchen car was fitted with a cooking range, a dresser with cupboard, table, sink, and draining rack. Two types of ranges were seen, one known as the "Army Range," burning coal, and a gas range fitted for gas. Over the range is a hot-water tank holding 50 gallons. The interior of the compartment about the stove was lined with steel plates kept about 2 inches from the walls, the intervening space being packed with slag wool to avoid risk of fire. (Fig. 10.)

Next to the kitchen a small compartment was fitted up for cooks. The remaining portion of the car was sometimes used either as a men's room and stores for field units, officers huts, or for stewards store or pack store. A view of the medical officers mess in the staff car appears in Fig. 11.

SUMMARY OF MATERIAL DATA

Military Ambulance Trains.—The trains were made up of varying numbers of coaches from 9 to 16. Each coach was from 50 to 54 feet long and 8 feet 6 inches wide. The length of the train varies with the number of cars, from 477 feet in a 9-coach train to 939 feet in a 16-coach train. The weight of trains varied from 438 to 492 tons.

Summary of personnel data: Patients, 98 to 442; M. O's., 2 to 4; R. A. M. C. personnel, 8 to 34; nurses, 2 to 4; cooks, 3.

MATERIAL

Train	No. of coaches	Length of coaches	Width of coaches	Length of train	Weight of train (in tons)
No. 1, Gt. C.	9	50	8′ 4″ 8′ 6″	477	.....
No. 20, Gt. E.	16	54	.....	864	438
No. 4, Gt. W.	9	.....	.....	.....	.....
No. 3, Gt. E.	9	.....	.....	.....	.....
No. 2, Mid.	10	.....	.....	481	.....
No. 8, L. N. W.	9	.....	.....	.....	.....
Lanc. & York	16	.....	.....	939	492

PERSONNEL

Train	Patient		Staff		
	Lying down	Sitting up	R. A. M. C.	Nurses	M. O.'s
No. 1, Gt. C.....	50	50–100	18	2	2
No. 20, Gt. E.....	162	280–442	34	4	4
No. 4, Gt. W.....	Both 98–98		8	2	2
No. 3, Gt. E.....	Both 100–100		.....	.....	.....
No. 2, Mid.....	Both 100–100		12	2	2
Lanc. & York.....	144	256 plus 64 infections 320	32 plus 3	4	4

Total, 530 persons. Total 638 if the cots in ward are used for sitting up cases.

My indebtedness to the managing editor of the *Railway Gazette* for permission to reproduce several illustrations and to utilize data respecting hospital trains appearing in that publication is gratefully acknowledged.

CARE OF PENETRATING WOUNDS OF THE CHEST AT A BASE HOSPITAL[1]

By Major HUGH McCULLOCH, M.R.C., and Lieut. Colonel WALTER FISCHEL, M. C., U. S. Army

THE following report is based on experiences and observations made at British General Hospital No. 12, at Rouen, France. This hospital was taken over and staffed by U. S. Base Hospital No. 21 in June, 1917, and operated by them until January, 1919. The patients treated all came to us through the British line of communications. The great majority were men of the British armies, but during the summer and fall of 1918 we also received the wounded of those American divisions which were fighting on the British sector. We found no marked differences between the wounded of different nationalities in respect to reactions to similar conditions. The series of cases on which we base this report includes only those cases which were seen and studied by us in the year 1918. In 1917 there had been over one hundred cases of chest wounds treated in our hospital, but as they had not been studied or handled in the same systematic way we have not included them in this report.

In considering our statistics it should be remembered, too, that all of these men came to us after a railroad journey of from eighteen to thirty-six hours. We very rarely saw a man whose chest wound was less than forty-eight hours old. Also, it is only fair to state that the worst cases theoretically were kept at the casualty clearing stations.

During periods of great activity we could not retain our cases as long as we might have thought wise, so it is possible that some of our patients may have died after reaching England. We heard of only one such, a man who left us in very good condition but with a fairly large piece of shell fragment imbedded in his lung. He died of hemorrhage soon after arriving in England.

The results which we obtained in the handling of our series of cases seem to have been somewhat better than was the average among hospitals similarly situated. In going over our records from time to time we checked up on our methods to see if we were following any peculiar or special line of treatment. Always we came back to the conclusion that each case must be considered by itself and the treatment adapted to meet special requirements. As our experience grew we certainly became more conservative in advising surgical interference. Yet when radical measures seemed indicated to us we urged them immediately.

[1] Read at Annual Meeting of the Association at St. Louis, Mo., October 13 to 15, 1919.

Figures may mean much or little depending on their interpretation. The following are stated in order to give an idea of the work done.

Total number of patients with penetrating wounds of chest in 1918	539
Total number of deaths	44
Percentage mortality	8.16
Number of patients with wounds penetrating chest and diaphragm	57
Of these there died	14
Percentage mortality	24.6
Number of patients with wounds of chest and complete severance of spinal cord	8
All died. Percentage mortality	100
Excluding complicating wounds of diaphragm and spinal cord we had of chest wounds alone	474
Of whom there died	22
Percentage mortality	4.64

On admission to the hospital all chest cases were segregated in special wards. After the long and exhausting journey we found that the best treatment for these men was a warm bed and a few hours rest. As soon as possible after admission all the patients were examined by one or both of us and a tentative line of treatment planned. Men who *looked sick* were examined first. If they had been operated on at the C. C. S., their wounds were inspected. Frequently we found that wounds which had been sewed tight at the C. C. S., were sucking when they reached us. In these we cut sutures and inserted drainage tubes at once. Others had remained tight, but examinations showed signs of fluid. These were aspirated at once and the fluid obtained examined under the miscroscope and by culture. At first we advised opening the chest in all cases where we found infected fluid. Later we found that in some cases by repeated aspirations we could control the infection.

All cases which showed even suspicious signs of fluid were aspirated. If the fluid were found, we withdrew all we could get, and the aspiration was repeated in twenty-four or forty-eight hours, depending on the character of the aspirated fluid and the condition of the patient. All fluids were examined for bacteria. In all we had 407 cases with hemothorax, and of these 326 remained uninfected. Of the other 81 cases, 73 were operated, and in eight we were able to successfully combat the infection by repeated aspiration. In these 8 cases the invading bacteria were: gas bacillus in 2 cases, pneumococcus in one case, staphylococcus in one case, and streptococcus hemolyticus in the other 4.

In our series we had a total of 135 patients in whom a thoracotomy was done, with a mortality of 26, or 19.2 per cent. Not all of these were operated in our hospital, in fact 88 had been operated at the

casualty clearing stations. Of these 34 required a second operation in our hospital, and 7 of them died. The remaining 54 had been operated and closed up at the C. C. S. and did not require secondary drainage.

We were firmly of the belief that more of these cases would have come through without drainage if they had all been systematically aspirated for several days following the primary operation.

Of the cases which were operated for the first time in our hospital, 47 in all, 19 died, a mortality of 40.4 per cent. This high mortality we feel was due to the fact that all of these cases were operated late and at a time when the entire pleura was badly infected. In only three cases was it thought advisable to close the wound after removal of the foreign body and toilet of the lung and pleura. In two of these three it was necessary to reopen and drain.

In the care of the patients who had been drained there were several points which seemed to us of importance. We insisted that the patients should change their positions in bed, and set them up for periods each day. In this way we felt we secured better drainage of the pleura and also favored expansion of the lung. Especial care was taken of the diet and every effort made to build up the state of nutrition. We noticed that the grouping together of similar cases seemed to have beneficial effect. Each man watched the progress of his neighbors, and they all cheered each other on.

The drainage tubes had to be adjusted to the needs of drainage, as a tube too long or improperly placed acted as an irritating foreign body. In one case of long continued pleural infection with pocketing we finally succeeded in cleaning out all the pockets by using a cystoscope to properly place our tubes. We used irrgiation of the pleura with eusol or Dakin's solution only under special conditions. Our conclusions were that irrigations were indicated in cases in which a sluggish state had been reached with low-grade temperature, continuous drainage, tissues showing no response. In these cases, after a few days of irrigation, the condition was improved; however, we found that the irrigating fluids themselves might prove irritating if continued too long.

We are not prepared to state our opinion on the value of irrigations in cases which had not been opened. Our experiences were too limited. But our impression is that it is not necessary. The cases did well if the pleural cavity could be cleared and kept clear of necrotic tissue and blood, either by aspiration alone or by primary opening with complete toilet of the lung and pleura, closure and repeated aspirations. Again and again we come back to the importance of repeated aspirations.

Occasionally we encountered cases in which physical signs and X-ray both indicated the presence of blood in the pleura but repeated aspira-

tions were negative. In these cases we were dealing with extensive blood clots. Our procedure was to watch the general condition. If the patient were doing well, we left him alone, but if he showed symptoms of severe infection, we advised operation to clean out the entire pleura.

In general we noticed that the character of the wounds and the severity of infections varied with the type of the battle actions. During March, 1918, at the time of the great German offensive and the allied retreat on Amiens, the cases came to us in very bad shape, due to the disorganization of transport and the general depression of the troops. The cases often went as long as three days before receiving proper medical attention. Later in the dry summer months, with the change from retreat to advance, the conditions were much better, and our cases were as a rule much less severe.

The worst wounds were those caused by airplane bombs. They were always associated with extensive laceration of the chest wall and were badly infected.

Large shell fragments were next in seriousness. Rifle and machine-gun bullets caused the least dangerous wounds. They were usually through and through and rarely carried in much infection. Shrapnel balls occupied a midway position; if they did not shatter ribs, they seemed comparatively innocuous.

We have not attempted to describe the surgical procedures in the cases treated by operation. Neither of us is a surgeon, and we turned over that side of the treatment to our surgical confreres. We are convinced that, as seen at the base, penetrating wounds of the chest belong under the care of a trained medical specialist but with the constant consultation of an expert surgeon.

We feel that much of the credit for the good results obtained in our cases belongs to the surgical assistance we always had. Lieut. Col. M. B. Clopton and Maj. W. M. Rainey followed our cases with us and skillfully took care of the operative procedures. We also owed much to the medical and surgical consultants of the Rouen area, Colonel Pasteur, R. A. M. C., and Colonel Dunhill, of the Australian Army Medical Corps. In their frequent and regular visits they gave us much helpful advice on doubtful cases and also kept us informed of what others were doing.

MUMPS: A REVIEW OF OUR KNOWLEDGE CONCERNING ITS ETIOLOGY, MODE OF TRANSMISSION, INCUBATION, AND PERIOD OF INFECTIVITY[1]

By CONRAD WESSELHOEFT, M.D.

Late Captain, M.C., 102d U. S. Infantry

THE importance of mumps is not generally recognized by the medical profession. The average practitioner is apt to consider this malady among the milder children's diseases, such as chicken-pox and German measles. In the medical schools mumps is usually accorded a few brief remarks from the department of pediatrics, and text-books are apt to reflect the common idea of its unimportance by recording meager generalities. The civilian practitioner may be justified, to a certain extent, in looking upon this disease with a degree of indifference because of its comparative mildness and rarity of occurrence, with the proportionately few complications and sequelae which come to his notice. To the army medical officer, however, mumps presents a very much more serious aspect. An epidemic of mumps in a unit of the army may temporarily deplete the ranks as seriously as other more formidable diseases. Common colds, or even German measles, might run themselves out in a command where the cases continued on full duty without any serious depletions from complications; but with mumps full line duty is usually too much for the acute stage, and, furthermore, the relatively high percentage of complications demands hospitalization, not only for the welfare of the individual patient but equally for the working efficiency of the unit. From the standpoint of the surgeon with troops, therefore, the problem of dealing with mumps demands the fullest attention to modern researches and inquiries on the subject, and these could well be utilized to advantage by the practitioner or hospital internist. As a former surgeon with line troops, and as a visiting physician to a contagious hospital, the writer has attempted to clear his mind of certain vagaries regarding the disease which have been a frequent source of perplexity and vexation in regimental work, and in dealing with boards of health, and to bring the more practical considerations of the subject up to date.

A review of the literature has brought out certain features which may be of interest and of help to medical officers. In the first place, the greatest interest in mumps during the last fifty years has been displayed by army medical officers. The contributions to the study of

[1] From the Evans Memorial for Clinical Research and Preventive Medicine, Boston, Mass.

this subject emanating from military institutions outweigh in practical importance the contributions from all other sources. During our own Civil War 48,128 cases of mumps were reported, with 72 deaths [1]. There were 19,458 cases in the French Army during the years 1888, 1889, and 1890, with no deaths [2], and from 1888 to 1892, inclusive, there were 33,745 cases [3]. In the nineteen army corps of the German Army during 1898 amd 1899 there were 486 cases with two actual epidemic outbreaks of 67 and 83 cases each [4]. The disease is said to have been epidemic in the Second Balkan War, but no statistics are available.[2]

Throughout the European War mumps has played an important rôle in the great armies. It began in the fall of 1914, and, like other epidemic diseases along the front, invaded the mobilized armies of the neutral countries [8]. Captain [9], of the French Army, made observations on 700 cases at the hospital at Bégin between 1914 and August, 1918. Captain Orr [10], of the Canadian Army Medical Corps, records 902 cases out of 18,000 men passing through the camp at Surrey between December, 1916, and May, 1917. At Camp Wheeler, Georgia, from October, 1917, to March, 1918, there were 5,756 cases of the disease, an incidence of 32 per cent in the command. This epidemic in the 31st Division, described by Lieutenant Radin [11], is estimated to have cost the Government approximately $1,000,000.

Previous to the outbreak of the war, however, the literature contained a relatively larger number of observations on mumps in adults, where the complications attracted unusual interest. Hubbard [12] informs us that 3 to 5 per cent of deaf-mutism originates from mumps. In other words, of the 50,000 deaf mutes in the United States in 1915 approximately one to two thousand owed their condition to this disease. Orchitis is undoubtedly the most frequent complication. Military, naval, and lay observers give statistics regarding testicular involvement which range from 0 to 63 per cent, with subsequent atrophy in different epidemics, varying from 0 to 100 per cent of the orchitis cases. It is pertinent to remark here that the atrophy usually involves only a portion of the diseased testicle [13, 14, 15]. Several cases are on record in which the first manifestation of mumps was the orchitis, with a subse-

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[2] In 1913 there were 4,972 cases of mumps reported in Massachusetts out of a population of 3,920,983. Among these, 3,426 were males and 1,546 were females. The mobilization of soldiers and sailors in this state explains the much greater percentage in the male sex. In 1917 there were 7,125 cases, and in 1916 there were 2,318 cases reported. The incidence by sex is not obtainable for these two years. I am indebted to Dr. George H. Bigelow of the Massachusetts State Dept. of Health for these statistics.

Among 58,331 cases of parotitis reported in Denmark from 1870 to 1894, seven died, and two of these deaths were in infants less than a year old [5].

The youngest case of mumps on record is in an infant twenty-four hours after birth [6] and the oldest case is in a man of ninety-nine and a half [7].

quent involvement of the salivary glands [16, 17, 18, 19], and during epidemics of this disease it is not an uncommon experience to see cases of orchitis of undoubted mumps origin where there is apparently no previous history or subsequent development of a parotitis [20]. A further complication of orchitis is its occurrence in an undescended testicle [21, 22]. The age of the patient bears little or no relation to the incidence of orchitis once the age of puberty is reached, it being approximately the same in epidemics reported among schoolboys, cadets, young and old soldiers. Weigert [23] found orchitis more frequent in the cavalry than in the infantry, an interesting observation which must be left for discussion to a subsequent paper.

Girls and women succumb to mumps more frequently than is commonly supposed[3], and coöphoritis is not an uncommon complication.[4] The infrequency with which nurses are affected in military hospitals in comparison with the Medical Corps men must be explained on other grounds than sex susceptibility.

In the foregoing introduction I have not attempted to do more than to arouse the interest of the reader in the subject, and to demonstrate that mumps deserves more consideration in the medico-military literature of this country. Since the first duty of a medical officer is the prevention of the spread of disease, I shall take up in this paper a consideration of the present status of our knowledge of mumps as regards its etiology, mode of transmission, incubation, and period of infectivity with reference to quarantine.

ETIOLOGY

The causative factor of mumps remains undetermined. But this does not mean that we are entirely ignorant of its nature. It is perfectly obvious that the disease is infectious and contagious; and, since it is primarily an infectious disease of the salivary glands, we may very properly assume that the contagium gains entrance through the mouth by direct or indirect contact and finds its way to the site of its most favorable nidus, the parotid gland. Many clinical observers have laid stress on the pharyngitis accompanying the early stage, and Petrilli [33]

[3] In the epidemic at the orphan asylum in Moscow in 1840 there were 82 cases among boys and 80 among girls [24]. In the Geneva epidemic of 1848-49 Rilliet and Lombard treated 38 males and 35 females [24]. In the deaf and dumb asylum at Breslau (1864) 13 boys and 16 girls were affected [25]. Fabre (1887) [26] reported that in three epidemics he found 30 cases in men and 23 in women. Roger (1899) [27] reported 33 cases in males and 19 in females. In an epidemic in Norway (1900) the cases occurred as follows: 159 boys, 114 girls, 47 women, and 34 men [28]. In a Hamburg epidemic Schottmüller (1904) [24], saw more cases among females than among males. In a mild epidemic in Bombay in 1914 there were 15 cases in girls and 10 in boys [29].

Epidemics of mumps have occurred in girls' schools, the most famous being that of Saint Cyr reported by Dionis [30] in 1708. Later epidemics in girls' institutions were reported in Bombay [31] and in Russia (1902) [24].

[4] A complete review of this subject with a full bibliography has been given by Josephson [32].

goes so far as to assume that mumps is primarily a disease of the pharynx, from which it spreads to the salivary glands. In connection with this theory one might mention the cases of orchitis preceding the parotitis, a case reported by Chillingworth [34], where ovaritis preceded the parotitis, and the pancreatitis which sometimes accompanies the prodromal symptoms, as in the acute exanthemata and acute tonsillitis. Following the involvement of the salivary glands we may have more or less direct complications of the disease in the epididymis, testicle, prostate, ovary, mammary gland, pancreas, meninges, facial nerve, ear, eye, and heart.

Many efforts have been made in the last twenty-five years or more to isolate the organism, particularly in American, French, and Italian laboratories. Laveran and Catrin [35] (1893). Mecray and Wa'sh [36] (1896), Granata (1908), Herb [31] (1909), and others, have bent their energies in this direction. A diplococcus in pure and mixed culture has been isolated from Stenson's duct and from the parotid gland of acute cases, and has been made to produce parotitis when injected into Stenson's duct or the parotid gland of animals. The parotitis produced by such injections, however, was usually of the suppurative variety, and the organism experimented with by Herb was obtained from a suppurative parotitis. It is exceedingly doubtful from the evidence produced whether this diplococcus is the causative factor of mumps.

The recent work of Wollstein [38], however, demands full consideration, because the result of her researches has narrowed down the facts on this subject to something of tangible and practical importance; namely, that the disease is associated during the acute stage with a filterable virus in the saliva[5], which is sterile by the ordinary aerobic and anaerobic methods, but which, when inoculated into the parotids of young healthy cats brings about a definite parotitis not manifested in controls. The facts brought out by Wollstein offer a definite contribution to our knowledge of the etiology, and help to place our theories regarding the disease on more substantial bases than has been hitherto possible. Still it must be borne in mind that all attempts to isolate the causative element itself in any tangible form have succeeded only so far as to show that it can be transmitted with increasing virulence through successive inoculations; and its tangibility, even to this extent, rests solely on constant pathogenic manifestations in the cat. The following is a brief review of Wollstein's more important observations:

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[5] Granata was the first to experiment with a sterile saliva filtrate in rabbits. Gordon used a similar filtrate for intracerebral inoculations into monkeys [38]. Hadin [11] aspirated the parotid gland of mumps cases under aseptic conditions, obtaining a clear secretion which was sterile on all culture media, but he did not test it by animal inoculation. Nicolle and Conseil aspirated the parotid glands of mumps patients and inoculated the fluid obtained into the parotids of monkeys. After sixteen to twenty-six days fever developed and, in one case, the parotid became swollen [38].

The virus contained in the filtrated salivary secretions of children and adults in the acute stage of mumps, when injected into the parotids of young cats, produces a pathological condition similar in several features to mumps in human beings. The parotitis develops in these animals five to eight days after inoculation, and persists about eight days, being accompanied by a rise in temperature, leucocytosis, an absolute increase in mononuclear cells, and tenderness and swelling of the parotid with definite histological changes similar to those recorded in human mumps; namely, "edema of the interlobular connective tissue with mononuclear interstitial infiltration about the ducts and elsewhere." The pathological conditions set up by the filtrate are intensified after the third or fourth transfer to other cats (with saliva or gland emulsions), and diminish with the sixth or seventh transfer, being effective only once at the eighth transfer. The testicles of cats when inoculated with the filtrate develop an orchitis on the sixth or seventh day which persists ten to fourteen days, the histological changes "consisting of degeneration of the epithelium and interference with spermatogenesis." "Atrophy of the inoculated testicle occurred in several cats after the acute symptoms had abated."

"The virus is most readily detected in the saliva during the first three days of the disease"; but after the acute stage has subsided in the patient, all inoculations of the filtrated saliva are negative.

The filtrate from a recurrent case of mumps gave positive results on inoculation into cats as long as the parotid of the patient remained swollen. Reinoculation with the filtrate as soon as the symptoms of the first inoculation had subsided gave practically negative results. Blood serum from a cat three months after recovery from parotitis, when left in contact two hours with an emulsion of the parotid gland of an inoculated cat at the height of the disease, inhibits the action of the virus as shown by controls made with emulsion alone. Defibrinated blood from cases of mumps when injected into the parotids of cats produced a parotitis, the degree of which was in proportion to the severity of the symptoms in the patient from whom the blood was obtained.

The observations were made at two different times, the salivary filtrate from cases of mumps being obtained from children and soldiers with constant results. The wide field covered by these experiments offers much room for the discussion of practical considerations. Even the confirmation of the theory that the contagium is contained in the saliva is an important contribution, however obvious and therefore superfluous this may appear to that type of physician who looks upon all research as a waste of time unless "grandstand" results are accomplished.

The fact that the blood serum contains the exciting element of the parotitis tends to explain the manner in which many of the complications are brought about. Since the parotitis produced by the blood serum is similar in time and appearance to that obtained by the salivary filtrate, we may hold the theory that it is the "virus" and not a soluble toxin which is at work in other parts of the body. Furthermore, Wollstein states that "the lymph nodes on the uninoculated side were observed to be swollen and moist, as though the infectious agent present in the saliva had been carried to them, presumably by the lymphatics. The lymph nodes showed necrosis of the center of several lymph nodules,

while the sinuses were distended and the lining cells swollen." The swelling of the cervical lymph nodes was a marked condition in many of the soldiers who had mumps at the army camps near New York, from whom the saliva was used for these experiments. Swelling of the lymph nodes as a concomitant symptom of the disease has often been referred to by English and French authors.

From all this it would appear to be a reasonable supposition that the virus spreads from the parotid to the testicles via the body rather than by hand via the urethra, as is held by some. This is in keeping with the observations of Lewis [11], who found "that careful sterilization of the hands and protection of the glans penis did not reduce the incidence of the complication." Furthermore, other complications of mumps arising in various glands and organs of the body might thus be explained as being in the nature of metasteses from the original nidus of infection, since their characteristic is inflammation unassociated with pyogenic organisms[6]. Although we cannot rule out the possibility that a soluble toxin plays a part in these complications, we can imagine that an endotoxin of the causative organism itself is responsible[7].

If the circulation plays the important rôle in bringing about complications, rest is desirable during the acute stage. This does not necessarily mean rest in bed for mild cases, because, in Radin's series, patients who were allowed to go to meals and walk about the wards showed no greater incidence of orchitis than those who remained in bed throughout [11]. It is interesting to note the change of mind in Dukes [41] on this subject. In 1899 he states rather emphatically that if patients are kept in bed eight days, orchitis would not develop, but in 1900 he refers to this statement as incorrect, because, in a later series of thirty cases, he had 20 per cent orchitis, although "not one boy moved from his bed for any purpose whatever for eight days." However, this clinical evidence should not lead us to the other extreme of putting patients to duty about the wards or allowing them to indulge in violent recreation, as is sometimes permitted.

That the blood serum after recovery has an inhibitory action on the

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[6] The otitis media cannot be included among these complications, but the labyrinthitis and involvement of the auditory nerve could be. The meningismus which occurs may be attributed to the mumps virus, but severe and fatal forms of meningitis in the course of this disease may well be considered to be due to a secondary infection. For a recent discussion of the cerebral complications, see Casparis [80] and Haden [81].

[7] That the virus may pass through the placenta is evident from the following case reported by Homans [6], "who found in the child of a woman whose labor came on in the eighth month as the result of parotitis, a swelling of the left parotid gland, on the day after birth. The swelling increased upon the two next days and was distinctly painful." White [39] also reports that a nursing infant came down with mumps six days after birth, the mother coming down the following day. In this connection we may note that Merklen and Meléande cite cases where infants continued at the breasts of wet nurses ill with mumps without becoming infected [40].

virus is in accord with the clinical observations of Hess [42], who reports that of twenty children inoculated with 6 c.c. to 8 c.c. of blood serum from convalescent mumps cases, none contracted the disease, although fully exposed to it. As this author points out, the long incubation period favors the administration of this serum as a prophylactic measure. I have been unable to find in the literature any reference to the use of this serum in the treatment of the disease itself. The results of Hess and Wollstein should encourage work regarding its efficacy in the prevention and control of complications.

MODE OF TRANSMISSION

The mode of transmission of mumps is by direct and indirect contact. Under direct contact we have to consider kissing as the most direct method. The child with mumps kisses its mother, other relatives, and friends of the household. At night the mother kisses the other children one after the other, and thus the child with the prodromal symptoms of an acute disease may be put to bed first, and the contagium is then implanted a short time afterwards on the lips of the other members of the family. Among soldiers Kulka and Neumann [43] report the spread of the disease by means of a pipe which a mumps case was smoking immediately before his admission to the infirmary. Two of his companions took a few puffs from the pipe just outside the surgeon's office and were infected, while others sleeping in the same quarters with the man the night before escaped. Three things are brought out by this incidence. In the first place, contacts should be selected with the care and diplomacy of a detective rather than by routine methods, particularly when the symptoms of the patient preclude droplet infection[8]; second, smoking tobacco does not always disinfect the mouth, as some of our colleagues in and out of the army would have us believe; third, the pipe passed about in this Indian fashion is a method of contact transmission almost as direct as kissing. A less direct method is the cigarette package. An individual who proffers his package to others, allowing the dirty fingers to soil the ends of several cigarettes in the attempt to extract one, offers a chance of disease transmission comparable to the common drinking cup.

[8] Where contact infection is to be dealt with in contradistinction to a combination of contact and droplet infection, it is advantageous to consider the character of the soldier who is the source. I recall a case of diphtheria in a sergeant, a man of refinement, a college graduate, and particularly careful about his personal hygiene even under difficulties. At the time he was quartered in a room with twenty of his subordinates of the 101st Ammunition Train in one of the old stone barracks at Camp Coetquidon, France. He had had a sore throat for thirty-six hours before he was transferred to the hospital. Owing to the stress of work the contacts were not isolated. Repeated throat examinations and cultures from twenty-four possible contacts failed to reveal another case, and no further case developed in this command during the next two months. The next case of diphtheria occurred in an echelon at the front in comparatively good quarters, this time in a private of low mentality and careless as to his personal hygiene. Five contacts of this case came down with the disease.

Technically, the pipe in the above case may be considered as a fomes, but usually the conception of fomites infection carries the idea of a more indirect contact. Aldersmith and Schelly [44] express the opinion that fomites play a part in the spread of the disease and that this affords an explanation for certain reports as to the incubation period which seem incredible. Roth [45] reports one case where the doctor carried the disease from a mumps patient to another patient, the latter becoming infected with mumps while the doctor escaped. This is a typical example of the spread of the disease by hand, the physician having carried the contagium directly. We must bear in mind, however, that everything with which the hand of man comes in contact may be concerned in the spread of disesse. Just as the lips of the fond mother may be the most direct means of spreading the contagium, so the hands of the physician must be equally considered as a serious menace to his patients in the absence of an "aseptic conscience" a quality as important to the physician as to the surgeon.[9] The basin of water, the cake of soap, and the scrubbing brush should be more frequently used at sick call in the field. Soapy water is a disinfectant. Where water is scarce, the same water may be employed for several washings, as it tends to purify itself. At any rate, the mechanical removal of organisms by the scrubbing brush is unquestionably a safer procedure than dipping the hands into a blue or pink solution, or wiping them off with a towel moistened with the same.

The element of time is the important factor in infection by fomites. Since we cannot experiment with the causative organism, clinical observations must be our guide. Roth [45] reports the case of a woman of twenty who was admitted to the hospital with diphtheria and placed in a bed previously occupied by a mumps patient. Eighteen days after admission she came down with mumps, although all the bedding had been subjected to steam for two hours and to dry heat at 100° C. for another two hours. Roth incriminates the bedstead as the fomes. Certainly the experience of all contagious hospitals is in favor of the efficacy of heat sterilization with mumps as well as with other contagious diseases. But we must be consistent in disinfecting beds and wards. Everything with which hands or bedding come in contact must be washed, dried, and aired to accomplish this. The experiments conducted by Walcott [46] with reference to diphtheria should make us

[9] Joseph [25] (1864) noticed that in the epidemic at the deaf and dumb asylum in Breslau, many children who used the same drinking glasses and spoons with the mumps cases did not come down with the disease; and, furthermore, that even though he did not wash his hands after inserting the finger into the mouths of children with mumps before examining the mouths of well children with the same fingers he did not spread the disease. These observations are so at variance with clinical experience that we must consider them either as erroneous, or, as Schottmüller points out, as a corroboration of the natural immunity suggested by the morbidity statistics.

wary of relying on formaldehyde gas disinfection. The physician would do well to follow the surgeon in attempting asepsis in preference to antisepsis.

There is one instance on record of mumps being transmitted from a boy to a dog [47], which brings up the possibility that domestic animals are concerned in the spread of the disease. The case is so unique that I merely mention it without further comment. I have found no records of epidemics traced to water or milk supply, but food has been considered by several as a possible source of infection. Moser and Arnstein [48] considered this as a possible source in an epidemic on the eastern front, although fomites infection could not be ruled out, since mumps had been epidemic in the community previous to the billeting of their command in the area. In regard to the spread of mumps by fomites, it would appear from a study of the various epidemics that the contagium is spread to a large extent by indirect contact involving fomites, in which the time limit in connection with the element of drying is as yet undetermined. Nevertheless, I feel justified by my experience and that of others in assuming that the time limit is probably shortened to hours rather than days in the presence of fresh air and sunshine. In other words, drying seems to hasten disinfection.

INCUBATION PERIOD

Our knowledge of the incubation period of mumps is still in such an unsettled state that we continue to have conflicting rulings by boards of health and military authorities concerning the isolation of contacts. Writers on mumps have quoted former writers on this subject with no apparent effort to ascertain the origin of the statements given. Thus we find the incubation period given as ranging from three to thirty-five days, "or longer," and the average varying with different authors from fourteen to twenty-five days. For this reason it has seemed worth while to collect all the observations from the available literature in the hope of ariving at a more tangible idea of the subject.

During epidemics considerable interest has been directed to the incubation period in France, England, and Germany, but throughout we find comparatively few careful observations. Owing to the fact that the disease is infectious before the salivary glands become appreciably swollen—in other words, in the prodromal stage—and to the fact that missed cases are not infrequent, the precise date of infection is often difficult to ascertain.[10] This accounts for many inaccurate statements

[10] The following two reports of probable incubation periods are given as examples of the source of many of the observations recorded:

Jobard [50] cites an epidemic of mumps on board the *Medusa*, where the first case occurred twenty-three days after the ship had put to sea. The original thesis of this author is not available, but it is as possible that this first case was infected before embarkation as it is that an "escaped" mild or con-

TABLE I

Author	Reference	Date	Number of observations	Average	Minimum	Maximum
1. Wagner	49	1869	3	18	12	21
2. Jobard	50	1875	1	23	.....	.....
3. Laveran	50	1875	1	15	15	15
4. Jacob	51	1875	3	19	.....	.....
5. Soltmann	52	1878	4	12.4	9	18
6. Manby	53	1878	3	24	21	29
7. Luehe	54	1879	122	17.5	.....	.....
8. Fournié	55	1881	10	20.3	16	26
9. Dukes	41a	1881	57	18.5	14	24
10. Bettelheim	56	1883	2	23	22	24
11. Rilliet & Lombard	63	1886	29	19	8	26
12. Roth	45	1886	3	18	18	18
13. Müller	57	1886	3	14	14	14
14. Clin. Soc. of London	58	1892	133	18.5	14	25
15. Rendu	59	1893	2	18	17	19
16. Sevestre	60	1893	1	22	22	22
17. Catrin	61	1893	159	17.5	.....	.....
18. Antony	62	1893	42	19.5	8	30
19. Comby	3	1893	1	19	19	19
20. Bobrie	63	1893	1	24	24	24
21. Merklen	64	1893	3	15.7	15	17
22. Holt	65	1897	3	19.5	19	20
23. Dukes	41b	1899	33	18.5	15	22
24. Schottmüller	50	1904	1	20	20	20
25. Bloomfield	66	1905	2	23.5	22	25
26. Dukes	41c	1906	23	17.6	16	23
27. Falkenheim	5	1908	1	14	.....	.....
28. Feiling	67	1915	4	20	.....	.....
29. Radin	11	1918	2	16.5	14	23
30. Wesselhoeft	.....	1919	6	18.8	17	20
Totals	.....	.....	658	18.15	8	30

by observers, and it is surprising to note how few made personal observations on more than ten cases, from which their deductions were drawn. However, it is a very significant fact that all those who observed the greatest number of cases arrived at an average incubation period ranging from 17.5 days to 19.5 days. In Table I are included the available data to date, together with six of my own observations. If we take the average of each author as given, multiply it by the number of observations he made, and then divide the sum of these results by the total number of observations recorded, we get a total average of 18.155 days.

valescent case was on board when the ship sailed. This would be clearer if we knew the date on which the next case occurred.

Falkenheim [5] describes the case of a boy who contracted mumps in the following manner: "The mother declares, upon being asked, that similar cases had not occurred in the child's brothers or sisters, but a playmate of the patient was affected in a similar manner fourteen days previously." We may ask whether the playmate first showed the parotid swelling fourteen days ago, and whether the patient played with him on the two days previous to the appearance of this swelling. In other words, the true date of exposure is not clear.

TABLE II

Author	Date	Number of observations	Average
1. Luehe	1879	122	17.5
2. Dukes	1881–99	90	18.5
3. Rilliet & Lombard	1886	29	19
4. Clinical Society of London	1892	133	18.5
5. Catrin	1893	159	17 5
6. Antony	1893	42	19 5
7. Dukes	1906	23	17.6
Total	.....	598	18.09

TABLE III

Author	Reference	Date	Number of observations	Average	Minimum	Maximum
1. Leitzen	45	1838	.....	18	.....	.....
2. Lebert	68	1859	.....	.....	8	21
3. Gerhardt	69	1874	.....	14	8	21
4. Henoch	70	1892	.....	14	.....	.....
5. Comby	47	1897	.....	.....	18	26
6. Penny	71	1904	12	.....	18	25
7. Aldersmith	44	1905	.....	.....	19	21
8. Douglas	72	1905	3	.....	28	35
9. Hudelo	73	1905	.....	18	8	30
10. Edgecomb	74	1908	33	.....	.....	25
11. Krause	75	1911	.....	17.5	.....	.....
12. Weigert	23	1916	79	.....	18	30

When the averages of the six largest observations are taken, and the result computed in the same manner, we get 18.09 days, as shown in Table II. In either case, there is an error by reduplication, as the first fifty-seven cases of Dukes are included among those recorded by the Clinical Society of London. Table III consists of statements of experienced authors and miscellaneous observations which cannot be grouped in Table I. Although many of the figures as given in these tables are based on testimony which cannot stand the test of careful scrutiny, I have refrained from including records and assertions accompanied by testimony so meager as to carry no weight whatsoever. More complicated tables are hardly warranted when we consider the inaccuracies of many of the observations given. Consequently, the results are given for what they are worth, and, since the averages arrived at are so constant, they are certainly of significance.

One of the most interesting contributions to this subject is that of

Captain Orr [10], of the Canadian Army Medical Corps. This author has obtained his conclusion by a different methods from the others, but his result is practically the same. In an epidemic of 902 cases occurring at Surrey between December 30, 1916, and May, 1917, he tabulates the number of cases diagnosed daily during this period, charts the results, and analyzes the figures obtained by the periodogram method. Although there is a suggestion of a possible twelve- to thirteen-day incubation, which he himself considers of doubtful significance, there is a very definite oscillation of the chart every eighteen days through six successive waves. The mathematical demonstration of this eighteen-day cycle is very striking. Orr remarks that this seems to represent a phase in the left cycle of the causative organism which is maintained through several "generations." The use of the term "generations" is hardly applicable, as the generative cycle of the different malarial plasmodia and the rapidity of fission of the diphtheria and typhoid bacilli bear no definite relationship to the incubation period of the diseases caused by them. What is brought out by Orr's work, however, is a definite eighteen-day cycle of periodic infectivity during an epidemic of mumps, which conforms to the average incubation period as arrived at through the study of individual cases by others, and consequently corroborates the conclusion that this should be given as approximately eighteen days.

The practical bearing of this conclusion has to do with the management of contracts. Where sporadic cases of mumps occur in a command under peace-time conditions, it is advisable to isolate contacts—with due thought as to the possibility of actual contact infection—from the fourteenth to the twenty-fourth day after exposure. Providing that no cases occur among the contacts, they could then be returned to duty with their command. On the other hand, if cases develop among these contacts, those who escaped the first exposure cannot be considered as immune to the second exposure in the isolation camp. This error was frequently made by camp surgeons in the late war. The inconsistency of releasing contacts at the very time when an infectious disease was to appear in an individual (namely, just at the end of the average incubation period) and of releasing contacts after a second exposure, without giving warning to the medical officer of the command concerning this second exposure, resulted too often in the further spread of the disease at much the same rate as would have taken place without the costly misdirected energy of inconsistent isolation. The question of keeping the secondary exposures isolated for another similar period depends on the number of contacts, the number of cases developed in the command, and the economic results of such a procedure. Once mumps has become epidemic, the isolation of contacts is a difficult problem, but the principles involved

demand careful consideration.[11] During any large mobilization of recruits or in the zone of operations, the isolation of contacts in the face of an epidemic of this disease is hardly justifiable. Strict vigilance on the part of medical officers serving with troops for the early diagnosis of mumps is of great importance, and the knowledge of the fact that this disease is infectious in its prodromal stage, as well as a clearer conception of the incubation period, would help these surgeons to fulfil their duties in this respect in a more efficacious manner.

PERIOD OF INFECTIVITY

We now come to the subject of quarantine of patients. The period of infectivity of mumps is no more unsettled than it is with most infectious diseases where the causative organism has not as yet been isolated. Here again the main testimony must rest on clinical data, but we shall begin with the results of Wollstein's experiments, which afford the only laboratory evidence. This author concludes "that the period of infectivity of the mouth secretions, as far as this test is capable of indicating, is comparatively short and covers about one week, corresponding to the swelling of the parotid. A fresh swelling appearing in the opposite parotid gland would, of course, prolong the infectious period for a given patient" [38c].

We have abundant clinical evidence that mumps is contagious in the prodromal stage. This fact is emphasized in the report of the committee of the Clinical Society of London [58] (1892): "Mumps is very infectious at the time of onset of the parotitis, and during the prodromal stage, which, in order to be on the safe side, should be assumed to be four days. The chance of infection diminishes progressively from the onset of the parotitis, and has ceased three weeks after that date, and probably earlier." A discussion of this point at a meeting of La Societe Medicale des Hopitaux de Paris brought out valuable data.

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[11] The suggestion made by Lieut. Col. J. C. Gittings in THE MILITARY SURGEON (June, 1919, p. 642), to the effect that a previous history of infectious diseases be recorded on the soldier's service record might be of advantage. The accuracy of the average recruit's statements on this subject is sufficiently questionable to offer room for discussion. In the field and at an army post it is safer for the surgeon to examine each contact and question him at the time as to his past history. Nevertheless I do recommend that infectious diseases occurring during the enlistment period, regardless of the relative immunity conferred by one attack of the disease, be recorded on the service record.

The relative immunity conferred on an individual from one attack of mumps cannot be considered in this thesis. Suffice it to say that one attack usually does confer immunity for life, although many exceptions to this rule are on record. I could quote three cases from my own experience. The most interesting case of recurrent mumps is depicted by Leber [76]. A soldier in the French army was admitted to the hospital with mumps six times between November, 1912, and March, 1915. Each time mumps was epidemic in the units in which he served, and on each occasion the diagnosis was confirmed by the characteristic course pursued. Catrin [61] reports that out of 157 cases of mumps nine had had attacks one or more years previously. Fournié [55] states that five of his twenty-four cases had had mumps before. Manine [77], reporting on 122 cases on board two ships of the French navy, states that twenty-seven had had mumps previously.

Rendu [59] reported two cases infected by patients the day before the appearance of symptoms. Sevestre [60] and Antony each reported similar cases, and Comby [60] told of a girl who went to a dance the day before she came down with mumps and infected seven of her partners. Most authors mention the prodromal stage of mumps as being within the infectious period, even though they do not cite instances from their own observations. One of my own cases, a girl at college, unquestionably contracted the disease from another student who showed the first symptoms the day after the only possible contact between the two. In taking precautions to isolate all contacts, the prodromal stage of the patient should be considered to extend forty-eight hours previous to the appearance of the parotitis.

As to the duration of infectivity, although this is arbitrarily set by different authors at periods varying from four to five days (Rendu [59]) to twenty-five and thirty days (Comby, [47], Weigert [23]), the general trend of the experienced authors is to be guided by the duration of the symptoms. From the economic standpoint I believe that this course is advisable during epidemic conditions, both in the Army and in civil life.

Such a period could warrant a release under ten days. The retention of a mild case of unilateral mumps after the initial subsidence of the gland, with the idea of watching for further glandular involvement or sequelae, is not justified in the Army during an epidemic, since the late incidence of further glandular involvement and complications does not warrant the continued hospitalization of the otherwise healthy individual capable of performing full duty. The cost of such hospitalization to a division in the zone of operations is probably out of proportion to the loss of man-power in the field resulting from the return of cases released early, either by recurrence in other glands, complications, or so-called "return cases." The early return of such mumps cases would call for more vigilance on the part of battalion surgeons, the sort of work in which medical officers can show professional ability more akin to our general ideas of the science and art of medicine than those arduous and far-reaching responsibilities in sanitation and hygiene. Furthermore, such a procedure necessitates that the medical officer of the hospital shall examine all cases for discharge, retaining for temporary duty in the hospital cases where there is persistent swelling of a salivary gland, and discharging those in whom the swelling has subsided, regardless of their stay in the hosptal. In this connection it is important that he examine all the salivary glands.

Of course every effort should be made to separate a unit which is free of the disease from a unit which has been contaminated. In the

zone of operations this is not always feasible, and the civil humanitarian must bear in mind that in time of war the aim of all branches of the service, including the Medical Corps, is the defeat of the enemy in the shortest possible time with the least expenditure of life and money. With this in mind it is conceivable that circumstances can exist where the strategical situation prohibits the realization of our ideals regarding isolation pertaining to a disease such as mumps. Nevertheless, when conditions do warrant an attempt to realize our ideals in this respect, immense saving can be accomplished. Particularly should this be carried out in barracks, and on transports, cruisers, and dreadnaughts, where isolation facilities are available. An example of the results of strict separation of units is depicted by Laveran [50]. In 1874-75 mumps became epidemic on the Island of Oléron, where there was a garrison in the castle. In January mumps broke out among the 250 soldiers quartered in the right wing of the castle. The left wing contained 220 marine cadets. These latter continued a more drastic training in the bad weather than the soldiers, but with the strictest isolation from these soldiers and the civilians this younger unit entirely escaped. When we consider that this was accomplished almost fifty years ago, we should be encouraged to make greater efforts along this line.

With sporadic cases a twenty-one-day quarantine period dating from the onset of the symptoms would be the safest and perhaps the most economical. When we set any definite time limit we are confronted with the problem of parotid hypertrophy following mumps. Very little is said about this in the literature. Merklen [64] reports a case in which the parotid remained swollen four weeks. Albert [78] writes of two buglers in his regiment who were the only cases to show relapses out of forty-five cases of mumps in the command during 1893 and 1894. Each of the two had three relapses. In one the parotid remained swollen after the second relapse and the swelling persisted for ten months, while in the other it remained swollen for eight months after the third attack. The fact that these two musicians were the only ones out of forty-five cases to show relapses, together with the fact that in each case the relapse followed closely upon the resumption of the use of the instrument, is of significance, particularly since the author clearly differentiates these cases from gas blowers' tumefactions of the parotid. Antony [79] speaks of one case of unilateral tumefaction persisting for one year after the attack of mumps, and of another case where it persisted for "several months."

I recall two soldiers of infantry in the A. E. F. who were kept in the hospital three weeks, and returned with unilateral parotid enlargement without tenderness. For two months following their release no new cases

of mumps developed in their respective companies. One of these men was wounded in action six weeks after his return. The other was gassed, and at the hospital was diagnosed as mumps during his convalescence, and quarantined, much to his disgust. He returned to the command with a perceptible swelling of the parotid, which I remember to have noticed almost six months after the acute stage. Although I did not have the opportunity of following these two cases through the acute stage, I am inclined to the belief that persistent enlargement of the parotid after the subsidence of the actue symptoms is the result of secondary infection of the gland with a walling-off process. This view is borne out by the fact that the pathology of tissues affected by the mumps virus in other parts of the body is characterized by a tendency to atrophic degeneration, rather than hypertrophy, after the acute stage.

The tenderness of the glands in these cases might be taken as an indication that the patients should be kept under quarantine, on the assumption that the secondary infection is keeping alive the infectivity of the disease, as in the suppurations of scarlet fever; but if my theory of a walling-off process is correct, such a conception of a prolonged infectivity is not without its flaws. However, ignorance should tend to make us cautious. A memorandum from the hospital to the surgeon of the unit on the return of such a case would stimulate observations as to any "return cases."

During December, 1918, and January, 1919, when the quarantine of mumps in the A. E. F. was according to the duration of the symptoms— the men usually returning after eight to twelve days— the incidence of mumps in the 102d Infantry did not apparently increase, in spite of crowded billets, the influx of replacements, and vigorous training in rain and snow. Furthermore, contacts were not isolated at this time. However, it is well to remark at this point that during the first year of the Civil War there were forty cases per thousand men, and that in the second and third years the number fell to twenty-three per thousand, and in the fourth year to fourteen per thousand. This epidemiological factor should be taken into account when we consider that in December, 1918, we were well along in our second year of the war.

When the full data on mumps during this last war is available from the Surgeon General's Office we may be able to gather some useful information in connection with the period of infectivity. If it bears out the policy adopted in the later days of the A. E. F.—namely, the minimum quarantine period according to the duration of symptoms—we shall have made distinct progress in our knowledge of mumps, which, if applied, will result in immense economic saving both in military and in civil life.

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THE PARAFFIN-WAX TREATMENT OF BURNS, WITH SPECIAL REFERENCE TO MUSTARD-GAS BURNS

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THIS article is an attempt to present to its readers a survey of burns in general, and also a résumé of my work, reading, and observations on mustard-gas burns in particular, as seen in the American Expeditionary Forces. The work was done in Base Hospital No. 64 at Rimaucourt Hospital Centre, Haute Marne, France.

The use of ambrine in the care of mustard-gas burns is original as far as I can find in my efforts at reading all available literature, papers, pamphlets and bulletins, and my results were so thoroughly satisfactory and pleasing, that I trust this article may prove as interesting to the Surgeon General of the U. S. Army, as well as to all officers of the Medical Corps, and likewise to those of us who have recently served and returned to our civilian professional duties.

The medical profession as a whole agree as to the classification of burns into three groups, differing, however, from the six-type classification of Dupuytren, and in this survey the question will be considered as dealing with the three-type classification. In addition to this general discussion of burns, let us also spend a little time on that type of burns which we saw in the war zone and which incapacitated for a variable length of time the men needed in the lines, whom it was our duty as medical officers to return to their units as fit for duty in the quickest time possible and with the best possible results. But while we are generally agreed as to the classification of burns, there is general confusion and much misunderstanding concerning the treatment of them. None of the many methods have been totally satisfying either to the patient or to the physician. Let us start out with this conviction, viz., that the method of choice is that particular method or technique which accomplishes the following for the patient: First, relieves pain; second, permits rapid healing and returns the patient to his work, or, as in our case, the soldier to his duty, at the earliest possible moment; third, the lessening of contracting cicactrices and along with this the prevention or limiting of deformities. Then to bring the attending surgeon into choosing a method which is the best for him we must consider, first, time as regards ultimate recovery; second, the ease of application; third, a pleased, comfortable, gracious patient during the treatment; fourth, gratifying results.

A superficial review of burns in general presents for study these facts:

Symptoms.—Of a severe burn we have local symptoms presenting themselves with pain, and inflammation varying in intensity or degree, depending on their extent. Constitutional symptoms are present likewise. In all burned cases of any severity, our first thought must be shock. We can all recall cases admitted to our various hospitals and dispensaries showing a weak, thready, running pulse, shallow respiration and the whole picture of shock, putting us face to face with the immediate care of this condition. The patient may die without showing any reaction, but usually, unless the burn is extensively severe, there is a reaction followed by a severe reactionary fever, with, however, a tendency to congestion of the internal organs, which fact is never to be lost sight of. There follows, in many cases, vomiting, diarrhea, hemoglobinuria, albuminuria, and often enlargement of the lymphoid tissues throughout the body.

DeCosta has found extensive blood changes which might be enumerated as follows: (1) Polycythemia, which is due both from venous stasis and loss of blood plasma; (2) leucocytosis; (3) increase of blood plaques; (4) a tendency to clot. This clotting tendency may be the cause of damage to various organs and structures, and this along with the generally altered blood, some damages to the excretory organs are very prone and usually are seen in a mild or severe degree in every case. Along with these changes in the blood we must always keep in mind the loss of power of throwing off of the body excretory products in proprotion to the extent of the area burned, the formation of toxins at the burned site, and their absorption into the system already reduced in its excretory powers. Thus we have a gradual accumulation of waste products, augmented by toxins from the burned area, in a system with decreased eliminative facilities, and in a system going through the thralls of shock. In addition, another factor makes itself felt, viz., the disintegration of the red blood cells brought about by the reactionary high temperature, and "these products of corpuscular degeneration" may cause irritation or thrombosis of the kidneys or other viscera. This all makes us quite a complex problem and not one of a burn *per se.* In all burns of the head, one must be on the lookout for inflammation of the brain; in chest burns, for lung inflammation; and in abdominal burns we must be scrutinizingly careful of abdominal inflammation. The usual burn complications are considered to be some damage to the lungs, kidneys or stomach. The danger of burns depends on their extent, degree and situation. The prognosis for a patient with a burn of a large area superficially is much worse than with a small, deep area. I shall not attempt to go into a discussion of the so-called Curling's ulcer, which is said to be located in the first part of the duodenum, other than to give its supposed causes, of possibly the

presence of toxic material (from the burn) in the bile, or from septic emboli; or as Moynihan claims it to be an ulcer toxic in origin only consequential to septic changes: the exact nature of these ulcers *in vivo* is not known, for I think none have ever been operated on.

Are burns infected? Clinically and bacteriologically all burns are sterile during the first few hours following the receipt of the burn, but thereafter they are all bacteriologically infected and all the more so after the skin begins to slough and become necrotic; and smears taken from the burned areas show saprophytes and cocci, so let us consider all burns twelve hours after receipt as infected wounds.

This hasty review of burns as a general question brings us up to a consideration of "Mustard Gas Burns," so-termed. These are the results of kultured warfare and are caused by a chemical, acting as a vesicant with the scientific name of dichlorethyl sulphide, but passing censorship as mustard gas, or yellow cross substance, deriving its name from its mustard or garlic-like odor. It exerts its irritant action as a vapor in low concentration in the air or by direct contact from splashes of the liquid; it is an oily liquid and is used in shells and scattered from them on the ground, where it slowly evaporates. This not only exposes those in the immediate vicinity of the shell-burst, but may also affect those who go over the contaminated ground later. The fluid may be scattered on clothing, shell-casings, rifles, etc., and may thus become effective through direct contamination of the skin. No irritant effect is felt at first, whatever the concentration may be, but after a delay of two to six hours, or even up to two to three days, the skin begins to react with a progressive inflammation that may progress to blistering and to local necrosis.

Skin Areas Involved.—The face alone seems to be in a class by itself in escaping its vesicant or escharotic action. The areas most severely involved are the axilla, penis, scrotum, perineum, inner surface of the thighs, the flexor surface of the joints, and the buttocks. Where the skin is sodden with fatty perspiration, as the axillae, perineum and flexor surfaces, the burns are the most frequent and severe, for there is a resolution of the gas brought about by the action of the moisture. The vapor or liquid clings to the clothing, and thus it continues to exert its irritant action. The burns ranged in degree from first, second and third, some cases showing simply first-degree burns with red erythematous patches on the body, some blisters, and others presented deeply burned areas. A combination of all degrees was common, but not necessarily constant. Edema of the burned areas is rarely seen, excluding the extreme edema of the penis and scrotum, and also some of the eyelids. In the areas showing simply the erythematous, sunburned

reaction of the skin, there may be excoriation of the skin, or the skin may be retained while the erythema gradually fades, being replaced by a brown staining or bronzing. The early burns appeared as a rule in twelve hours, and they were usually severe, presenting the appearance of large, erythematous patches covered with large bullae, which contained a serous, sero-purulent or purulent material. The contents of these bullae are impregnated with the irritant chemical and, if the blisters are opened, allowing the contents to come in contact with one's skin, you in turn will suffer from itching and burning of the involved bathed areas; therefore in opening the bullae it was the routine to make use of a hypodermic needle in withdrawing their contents.

The erythematous areas cause a burning or itching similar to sunburn. The inflammatory reaction is chiefly superficial, and the dusky red color deepens and desquamates. The inflamed skin becomes very fragile, and the surface layer is readily loosened by pressure or careless rubbing. The blisters formed are almost painless in their development, but the raw surface that is left after the bullae are broken becomes most acutely sensitive because of the exposed nerve buds. Deeper destruction of the dermis may be caused by the spreading of necrosis, where the substance attacks the skin in high concentration, or when secondary infections are implanted on the raw surface. The purplish-brown, brown or brownish-black tint usually appears in areas that were first inflamed and red, but it may arise without any preceding erythema. This appears from five to six days and upwards, and persists for several weeks, ending by desquamation of the stained cuticle; this staining is not a deep or permanent pigmentation.

The lesions are chemical burns, unlike those produced by heat, electricity or the ordinary corrosives as sulphuric acid, nitric or hydrochloric acid or the strong alkalies: they resemble the hydrochloric acid burns nearest of all these agents. They differ from heat burns in the absence of thrombosis, in the greater moistness of the affected area, and in the fact that the necrosis requires some time for recovery. The coagulated, shrunken, cooked appearance of tissues in heat burns is not apparent in the tissues of mustard-gas burns. The blood-vessels are damaged and are collapsed, causing a local anemia. There is a peculiar deep penetration of even a minute quantity of the "gas," and no doubt its entrance is by way of the hair follicles, sebaceous and sweat glands. The lesions remind one of a roentgen ray burn of the skin, in that healing is slow, owing possibly to the blood-vessel injury. The retention of the irritant in the hair follicles and the sebaceous glands is evident by the many cases showing "return of burn" after baths taken even up to one month after the burned area has completely healed over,

this probably being due to water decomposing (a characteristic property) what remnants of the chemical are still deep in the tissues.

Treatment of Burns in General.—We are all cognizant of the many various methods of treatment put forth by competent thinkers and conscientious workers, and each of us has seen results from the various methods, but do they all come up to the mark and do they all reach the goal we are striving for, and do they answer the questions outlined at the beginning of this paper? We have seen used the sodium bicarbonate wash, the normal salt solution treatment, the wash of peroxide of hydrogen, the various bland powders separately and admixtures of several; the application of picric acid as a paste and as a solution; the use of carron oil and many pastes of various composition. The treatment of burns had another star in its crown when the dry air method came into vogue, also the application of nature's sun rays and of manufactured light and heat. All these methods have been tried through many years, and each one is found wanting when we come face to face with the dictum we laid down for ourselves and to which I trust we all agree.

As I tried to bring to your attention again when considering the symptoms, our first duty in a burn of any severity is the treatment of shock, by morphine, stimulants and heat. We must prevent any additional shock in handling a burned patient, and so, if there is any extensive body burn, the uninvolved body surface is not to the exposed while we are dressing the case. If there is more than one burn on the same individual, only expose and dress a single burn at a time. In burns of fingers and toes we must continually be on our guard against "webbing," and so we must prevent apposition of parts by the interlaying of dressing material. In the aged we must be on the lookout for hypostatic pulmonary congestion. Contractures, that bugbear of burns, always stares us in the face and cry out to us, "Beware and prevent!" Here I might state, as regards shock in mustard gas burns, it was my experience that it was a negligible factor; the patients I treated had been "gassed" in the Argonne and, in addition to their body burns, the vast majority had also some inhalation effects, many showing intestinal manifestations. They were all fatigued, body-weary, fighting men.

Seventeen years ago Barthe de Sandfordt, in China, first made use of a paraffin-wax in the treatment of burns. The medical profession of very recent years has seen evolved a series of waxes and paraffins for the treatment of burns. The paraffin-wax treatment is the most recent step in the treatment of burns, and some men adhere to one formula while others stick to another. Some preparations have been made by dissolving in a paraffin base such antiseptics as acriflavine, brilliant-green,

dichloramine-T, oil of eucalyptus, etc. It is difficult to incorporate these antiseptics in a paraffin base, and for this reason the mixtures are not entirely satisfactory. As regards these preparations, I have had no personal experience and so cannot truly discuss their pros and cons, only knowing that the preparations are difficult to make. The so-called new antiseptics of the war have also been used in the treatment of burns primarily alone, then using a wax, and some men claim very satisfactory results. A formula of great use throughout the British Isles is a formula of Colonel Hull, known as No. 7, paraffin formula of Colonel Hull and composed of the following: resublimed Bnaphthal, 0.25 per cent; eucalyptus oil, 2 per cent; olive oil, 5 per cent; vaseline 25 per cent; paraffin durum, 67.75 per cent. The olive oil in this preparation may become rancid. After many preparations were made by de Sandfordt, he finally perfected and put on the market a preparation of paraffin wax going by the trade name of Ambrine: its formula is a secret. The physical properties of this paraffin wax preparation are the following: neutral, non-irritating, a low melting point, is adhesive, non-brittal, and is elastic: it is solid when cold and at a temperature of 140 to 150°F. it is as thin as water; heating for eight to ten minutes at 250 to 260°F. renders it aseptic. Each of these properties is essential in the proper make-up of a wax to be used and to carry out the principles outlined for its application.

Many men claim that it is entirely wrong and against good surgical judgment to seal up burns, infected as they all are. But let us call to mind a severe case being dressed with powder or solutions, with the use of gauze; think of the painful and cruel removal of the gauze after it has become enmeshed in the burned area and the granulations. Aside from this picture, what happens to the fine scattered islands of epithelium striving for an existence and a foothold, and doing nicely until we with our methods of treatment come along and tear them asunder, cause a bleeding, granulating surface, and thus delay healing that much longer.

By the paraffin-wax treatment, in my series using ambrine, the patients are dressed without pain; they are easily and quickly dressed, both in applying and removing the dressing, and are comfortable during and after the dressing. The ambrine contains no specific medicinal ingredients but acts mechanically. The wax-cotton dressing is a non-adhesive shell, prevents the entrance of air to irritate the raw surface with its exposed nerve ends, maintains a constant temperature and acts as a splint to the proliferating tissues of the burned area. The dressing acts as a "poulticing splint" to the underlying traumatized tissues. Shortly after appliction, normal wound secretions form under the dressing, thus lifting it from off the wound or burned area and forming a shell, and to this fact is attributed the ease of redressing, not causing any bleeding nor harming the new regenerated epithelium.

As told us by Dr. Sherman, burned areas treated by paraffin-wax method, heal two to three times more quickly and are free from cicatricial contraction with a minimum of scar tissue. As the same worker and writer has said, third-degree burns heal with some scar tissue, but it is infinitely less than with any other method and the scar does not have the tendency to contract, thus preventing the disfigurements and loss of function of parts incident to cicatricial contraction. The healed scarred area is found to be supple, and not tough, dense and thick, as is so frequently observed following other methods.

Two hundred and fifty-eight mustard-gas burned cases were under observation in my series, and they ranged from first to third degree with areas varying in size from that of a lima bean to the whole buttocks and extensive ones on the hands and thighs and body: they were all admitted to my care infected. Their previous dressings had consisted of the alkaline baths, lotions, dusting powders and many simply of vaseline. The cases hardest to handle were those presenting burns and excoriations of the penis and scrotum and inner surface of the upper thighs. At the outset it was my practice to dress all burned areas as follows: a sodium chloride sodium bicarbonate solution (sod. chlor., 70 gms.; sod. bicarb., 150 gms.; Aqua Dist. q. s., 5,000 c.c.) was used under thorough asepsis, thoroughly cleansing the burn and surrounding area, completely drying and then applying a dusting powder of the following formula—zinc oxide, carbonate of magnesium, carbonate of lime, of each 200 gms., talc 400 gms. After the application of this powder, sterile gauze and bandage were applied. This was the treatment outlined in an overseas medical corps bulletin, and it was given a thorough tryout but was unsatisfactory. The patients appeared comfortable and claimed that the dressing was easy. But the results were not gratifying, the procedure of removal of dressings was anything but pleasant for the patient and clearly showed the error in technique when at each dressing a sanguineous wound presented itself, even with the utmost care at time of dressing. The whole healing process was sluggish and unproductive of rapid, satisfactory results. After a trial of this method I resorted to the use of ambrine and continued it in all the remaining cases. The technique of the dressing of the penis and scrotum was somewhat different and markedly more painful, for here we were dealing with extremely sensitive areas, edematous, weeping, and the vast majority showing extensive excoriation, and in one case there was complete ulceration through the scrotum. One can well imagine the torture these men went through when lying as quietly as possible in bed, and the added torment each dressing caused them. The progress in these cases was not as satisfactory as one could wish for, and healing was very sluggish. Here I used

mostly the alkaline treatment, with thorough cleansing of the entire area each morning along with suspension of the penis and scrotum by large cotton-gauze perineal pads. All these burns were extensively infected and gave off a very offensive and nauseating odor. It has been my privilege to see several healed mustard-gas burns of the penis, months after recovery, and the skin presented a thick, leathery, puckered appearance and consistency and a constriction effect, in one case necessitating circumcision.

A very interesting laboratory treatment and report of "the treatment of dichlorethylsulphide (mustard gas) injuries," emanated from the University of Michigan Pathological Laboratory and presented by Warthin, Weller, Roos, and Hermann appeared in the *Journal of Laboratory and Clinical Medicine*, dated October, 1918. I regret that the method employed by them in their scrotal and perineal burns, viz.: the sitz bath with Dakin's solution, had not been tried by me in the treatment of similar cases, all infected, and which were so sluggish in my hands, for I can see where that method may have been of some value and comfort to the patient, but their series and mine differ entirely: mine being exhausted soldiers evacuated from the Argonne, gassed throughout, meaning by this, most of them blinded (temporarily in the majority), showing the deleterious effects of gas inhalation, depressed and suffering from burns of various other parts of their body in addition to the scrotal and penis burns, and all bedfast, sick patients. A man who has been gassed is down and out, temporarily at least, physically and mentally, and all his alertness and fight are removed and you have a problem quite different to handle than a laboratory subject. But I disagree with them in the use of "air-excluding and infection-including protections," for my results from the use of ambrine were thoroughly satisfactory in every detail and a comfort to the patient, all proclaiming it the best and the most comfortable treatment they had had from the time of reception of burns, and there was noted the complete absence of that dread of dressing in all my cases.

The technique I followed in treating my series of cases was not time-consuming nor painful in the slightest degree, and is simple and economical. I was greatly handicapped at the outset by lack of proper paraphernalia and resorted to as fine and soft a shaving brush as the usual French shops offered, but even with this the dressing was thorough, easy and painless. I finally instituted the use of a simple De Vilbiss atomizer in spraying the ambrine on the burned area and can truly say it proved very satisfactory, but not convenient, for one had to be near a hot stove to keep the neck and nozzle warm in order to prevent congealing of the ambrine after it left the container en route through the

nozzle, and if this did clog, the instrument from elbow to end of nozzle had to be heated to render it useful again. On this account it can hardly be of much use routinely. The most satisfactory instrument for applying the ambrine is the atomizer devised and perfected by Dr. Sherman of Pittsburgh. It is simple, efficacious, and retains its heat, in its double-boiler effect, for a suitable time, preventing the paraffin-wax from stiffening and also preventing the splashing of water into the paraffin-wax during its preparation.

My technique is an application of the Carrel technique, and I think here we have found a wide application for its use. Here again I was handicapped with no available neutral soap for cleansing the wound, but I used an emulsion of ivory soap. This is as bland and as neutral a soap as obtainable, and it proved as satisfactory as possible, knowing there was nothing better available.

Caution may be made here of allowing no water to splash or splatter into the paraffin-wax during its melting, for this will make the dressing painful. The paraffin-wax may be applied to any burned area at a temperature of 150° without fear of pain or burning.

On removal of the dressing one finds the paraffin-wax-cotton shell raised from the area and the whole area bathed with lymph and a purulent secretion, and in the early stages there are sloughing masses. There is often an offensive and nauseating odor, but this is no contraindication to the treatment. If there is an extensive, deep sloughing burn and the clinical picture is that of absorption of toxins, with local manifestations of infection as edema, redness, lymphangitis, the paraffin-wax treatment ought to be changed to the instillation of sodium hypochlorite solution until the toxemia and absorption have subsided; then institute the wax treatment again.

At the first dressing, say within twelve hours after receipt of burn, it is not necessary to scrub or wash the area with soap or antiseptics, for the tissues are sterile as a result of the burning and so we need not traumatize the tissues any further. None of my gassed cases were evacuated to our center before two or three days after receipt of their gasburns.

Unless there has been very extensive destruction of tissue, skin graft is unnecessary after the use of paraffin-wax. If necessary, I have found the Riverdin method the most satisfactory, after complete sterilization of the burned area, by the Carrel technique. By this method, anesthesia need be only local in obtaining the grafts, and thus we save any additional strain to kidneys just recovering from a severe toxic taxation.

Don't put cotton or gauze direct on any burn.

Don't discontinue paraffin-wax treatment on account of odor.

I have had the opportunity to treat burns of all degrees, received from

many causes, and the results obtained are worthy of the effort expended. Steam, boiling water, gasoline, hot grease, electric, fire and mustard-gas are the causative agents in the cases of my overseas series, and the ambrine treatment was used with uniform results in all.

I have had no experience with the so-called ambrine paper.

The technique of dressing is important and must be carried out with care and precision, always bearing in mind the principles of the Carrel technique.

Steps of the dressing.—(1) Removal of dressing.

2. Bathing area with neutral sodium soap (warm or not).

3. Use of sterile absorbent cotton pledgets on sterile hemostat. These pledgets are soft and are similarly "soaped" and the whole area is cleansed, with a circular rubbing motion, from center to periphery-Thorough scrubbing of skin periphery.

4. Removing soap with warm sterile water and sterile cotton pledgets.

This cleansing process is one of the most important steps in the technique. There should not be any bleeding, pain or distress, and if there is any of these, the technique is not being carried out properly. Oftentimes the secretions are more easily removed by substituting normal salt solution for the sterile water.

5. Thorough and complete drying of the area, either with dry sterile cotton pledgets or by means of a blower. The area must be dry before applying the paraffin-wax.

6. Spray ambrine, or the paraffin-wax preparation, over the burned area and at least over a quarter inch of the peripheral skin.

7. On this layer of ambrine, place immediately as thin a layer or film of sterile absorbent cotton as possible to obtain from a roll, this layer likewise extending at least a quarter of an inch beyond the burned area edges. It is time-saving and more satisfactory to have these thin layers of cotton already prepared and placed between sterile waxed paper or in toweling, and then at the time of dressing, with sterile scissors the proper sized piece is cut off and placed on the first layer of the paraffin-wax.

8. On this film of cotton, spray a second layer of the paraffin-wax likewise extending beyond area edge.

9. Over this apply a thicker layer of absorbent cotton.

10. Then apply a layer of gauze and bandage. The amount of cotton and gauze necessary for the completion of the dressing can be judged from the amount of the secretions.

11. Redress every twenty-four to forty-eight hours, depending on the amount of secretion.

12. Don't touch the wound or burned area with anything but the sterile cotton pledgets. Keep fingers off and out.

In concluding, may I recapitulate somewhat. All burns are sterile at time of their receipt; all burns are infected clinically and bacteriologically at least twelve hours after their receipt; the Carrel technique of handling burns is superior over any other method; the paraffin-wax treatment has proven its worth in every particular, both regarding the surgeon and also the patient, for time of disability is shortened, suffering is lessened, deformities and frightful contracting cicactrices are prevented, and the results are wholly worthy of the energy expended. I trust that other medical officers of the A. E. F. may have had some ambrine experience with mustard-gas burns, for I feel confident that the end results merit its addition to the Records of the Medical History of the World War.

SOME OBSERVATIONS RECORDED IN A SERIES OF ONE HUNDRED AND FIFTY-NINE MASTOID OPERATIONS AT FORT RILEY, KANSAS; FROM SEPTEMBER, 1917, TO AUGUST 1, 1918

By Lieut. Col. P. D. MacNAUGHTON and Capt. GEO. W. SWIFT

Medical Reserve Corps

DURING the winter and spring of 1917 and 1918, 159 mastoid operations were performed at the base hospital, Fort Riley, Kansas. The number of cases reoperated was 26, making a total of 185 mastoid operations. The table below shows the cases divided into months as follows:

	No.	*Secondary*	*Total*
September	1	..	1
October	1	..	1
November	5	..	5
December	28	2	30
January	16	1	17
February	23	2	25
March	29	4	33
April	28	4	32
May	17	6	23
June	8	4	12
July	3	3	6
Total	159	26	185

TIME OF PATIENTS IN HOSPITAL

The average time for the recovery of the entire series was forty-nine days or seven weeks. Uncomplicated cases averaged five weeks. Several cases with severe complications remained over the sixty-day period. Practically all cases were up and about the ward on the seventh day.

TYPES OF OPERATION PERFORMED

The simple mastoidectomy was the usual procedure. In a fair proportion of cases the posterior superior wall of the external canal had to be removed down to the annulus, due to the extensive necrosis. Primary radical mastoidectomy was performed on 15 cases. Ligation of the jugular and closure of the lateral sinus was performed in 4 cases. Extensive exposure of the dura was done in 4 cases where the radiograms showed necrosis of the dural plate. Drainage of one extra dural abscess and one temporal lobe abscess was performed, both cases recovering.

MORTALITY

Death from pneumonia, which was epidemic at that time, numbered 3 cases; septicemia from lateral sinus infection, 1 case; epidemic cerebrospinal meningitis, 3 cases; meningitis associated with, but independent of otitic disease, 4 cases; total deaths, 12; total deaths due to mastoid, 2. In connection with the above it is perhaps necessary to state that a large percentage of the cases of the series followed "flu" infection, many of them had had pneumonia before developing mastoiditis, and some developed the latter first and pneumonia, and, in a few, meningitis later. All the 12 cases that died went to autopsy, so it is possible to give the exact pathological findings. The three cases that died of pneumonia showed the characteristic changes in the lungs and a perfectly clean granulating wound in the mastoid with no complication from that source. The 3 cases of epidemic cerebrospinal meningitis showed the same normal healing process in the mastoid wound as the former cases.

In the case of general septicemia from lateral sinus infection a large clot was found in the sinus; this was removed and the autopsy showed endocarditis and a liver abscess. In the four cases of meningitis which were independent of otitic disease the dura was not exposed in the operation, and at autopsy the bone overlying the dura was in a healthy condition, showing no communication between the diseased portion of the ear and the dura. The dura on the operated side was in no worse condition than at more remote points, but there was evidence of sphenoidal infection.

COMPLICATIONS

Hearing.—The cases where radical mastoidectomy was performed were of the chronic type of suppurative otitis media, and the hearing was practicllay nil in all before operation and was not altered by the operation. Practically all simple mastoid cases recovered hearing to normal.

Facial nerve.—In 8 cases the facial nerve was involved; complete facial paralysis, 4 cases; partial facial paralysis, 4 cases. Of the partial paralysis 2 recovered. Of the 4 cases where complete paralysis occurred, 2 were extensive operations involving the labyrinth. Both cases recovered but lost the function of the labyrinth; they were of the chronic otitis media type with acute mastoid involvement.

Brain abscess.—In one case an extra-dural abscess was drained three weeks after a simple mastoid operation; recovery. The second case was an otitis media of chronic suppurative type of fifteen years duration. A sudden mastoiditis developed and the case was operated. Two days

later the pulse and temperature dropped to below normal; terrific headache, nausea and vertigo suggested a brain abscess. The dura was exposed and about a dram of pus was evacuated from within it. Two days later the patient suddenly became unconscious and a needle was inserted deep into the temporal lobe, evacuating a small amount of foul pus of a green color. The brain was incised, a tube inserted and a half-cup of pus evacuated, following which the patient made an uneventful recovery. The labyrinth had evidently not functioned for a long time, as good compensatory function had been established on the opposite side. The Barany tests showed no nystagmus from the operated side, no past pointing or falling sensations. Normal findings upon stimulation of opposite side. His history gave no clue as to the time of first labyrinth involvement, but the canals were not involved in the operation and one must assume that it was of long duration.

Erysipelas facialis.—This complication occurred in nine cases, none of which were serious. They all showed sluggishness in granulating and required several curettages. Applications of magnesium sulphate (saturated solution) was found to be the best remedy in these cases.

Parotid gland.—This gland was frequently involved and accounted for two cases of facial paresis, both of which recovered in about six weeks. The infection extended to the gland from the canal through the fissure. Careful toilet of the canal with iodine applications in cases where the streptococcus viridans was present in the canal was found efficient in preventing this complication. Opening the canal with a narrow bladed knife through the cartilage and inserting a probe through into the gland tissue, thereby establishing drainage, was all that was necessary. If the knife is inserted too deeply, a fistula is liable to result; they are difficult to heal. The first symptom of the glandular involvement is the inability to open the mouth. One is liable to diagnose this complication as one of mumps, especially in soldiers who have recently been exposed or where a case of mumps has developed within the ward.

Meningitis.—At Fort Riley, as at many other camps at that time, there existed an epidemic of meningitis (cerebrospinal), and it was only to be expected that cases would develop in any of the wards at any time as the patients came from the same camp and organizations in which the disease was prevalent. Notwithstanding the fact that every precaution was taken to limit the spread of this and other contagious diseases, there was bound to be some exposure, and this accounted for 3 cases in this series.

Of the meningitis of otitic origin there was but one case in the whole series. One case developed bronchitis, pneumonia, otitis media, mas-

toiditis, meningitis, and had recovered from all infections until meningitis took him off. Another entered the hospital with influenza; on the third day pleurisy was found. On the same day the left ear began suddenly to discharge; he was transferred to the Section of Head Surgery and on the sixth day a fulminating mastoiditis developed and he was operated on. The tip was literally blown away by necrosis. His temperature was irregular and suggested lateral sinus infection, and on the tenth day the jugular was ligated and the sinus packed off. His plural condition became gradually more pronounced and pneumonia of the lobar type developed. He died on the twenty-fifth day after his admission. Postmortem examination showed pneumonia, peritonitis, meningitis involving both hemispheres of the base; the dura over the temporal lobe was exactly the same on both sides and was not involved as in otitic meningitis, that is, there was no evidence of a localized infection, which can usually be easily demonstrated.

The third case began with follicular tonsillitis, followed a week later with pain in the ear and mastoid area. The third week after operation he began to complain of pain in his head on the operated side. The mastoid wound was nearly healed on the fourth week, when he suddenly became delirious and a spinal puncture showed streptococcus. He died on the following day. Postmortem showed no changes about the temporal lobe, but a diffuse meningitis over the base and both hemispheres. Case 4 developed the earache after being in swimming. He was treated for seven days. A threat culture showed streptococcus in large numbers, double plus, on admission to ward. The drum was not markedly infected, but there was tenderness over the mastoid area. He was not operated, and the symptoms were apparently subsiding when meningeal irritation developed. The spinal fluid showed pneumococcus type 1. He died on the eighth day of meningitis. There were symptoms of cerebral abscess, *i. e.*, headache, subnormal pulse and temperature, but the post-mortem showed the mastoid cells full of fresh pus, the dura intact, no apparent site of entrance and a diffuse meningitis over base and both hemispheres. This case was not operated, but we include it in the series as a good example of the complications encountered.

These four cases show no conclusive evidence of the origin of the meningitis, but do show that they differ from the one case of a true otitic meningitis. In the case of otitic meningitis a localized meningitis of distinct otitic origin was demonstrated. Microscopic examination of the tissues might be necessary to prove that the other three cases did not originate from the diseased mastoid, but other factors may be considered. Meningitis is a complication in pneumonias, probably by way of the blood stream. The mastoid infection, if the result of a blood-

stream invasion, could be associated with meningitis, in which case the lowered resistance and the operation would tend to favor almost any complication. Many mastoids show a localized meningeal irritation, which, when the dura is exposed, promptly subsides. Should these cases be neglected we believe they would develop a true otitic meningitis. The cases that developed meningitis in this series independent of the mastoid disease, we believe, were a blood-stream invasion. Early in this series it became apparent that the tonsil played an important rôle in the infections of streptococcus type. As the number of cases increased in which a fulminating tip infection presented itself with no middle-ear involvement the idea that the infection was of the blood stream began to impress us. In the next twelve cases blood cultures were taken before operation was performed and streptococcus hemolyticus was found in eight. In many of the previous cases, where no blood cultures were made previous to operation, the cultures made after operation showed streptococcus present for weeks after the mastoid condition had subsided. This led us to the conclusion, which was, of course, supported by postmortem findings, that mastoiditis is not always due to direct extension from the nasal and pharyngeal mucous membranes via the eustachian tubes; that the tonsil is the usual seat of infection of the blood stream; that otitic meningitis is a rare complication; that a general meningitis may occur with mastoid infection and be independent of the mastoid infection.

DIAGNOSIS

Headache.—Temperature, blood counts, pain, tenderness and swelling are all of great importance in diagnosis of mastoiditis, but are unreliable. This series has demonstrated to us that there is one symptom associated with otitis media or mastoiditis that is of the utmost importance, *i.e.*, the headache. It is always present and does not respond to medication; after operation the headache disappears, but as soon as meningeal irritation takes place or as soon, in fact, as extension from the mastoid to the surrounding parts begins to take place, even if the infection has not yet reached the dura, headache will be complained of. It may be located adjacent to the affected side or it may be reflected to any other part of the head; later when the meninges becomes involved there may be tenderness over the tri-facial area and the teeth are likely to ache and the gums to become tender.

When headache persists for several days after operation and cannot be relieved by drugs, or when it makes its appearance after operation on the mastoid it is time to consider uncovering the dura.

Of course the pain, swelling, tenderness over the mastoid are inval-

uable in making the diagnosis, as are the temperature and blood count. The temperature is not constant and may be subnormal or normal in the late stages. The pulse was more reliable than the temperature, and the blood count showed in most cases increased leucocytosis, but in cases where there was an old chronic middle ear infection with much ebonization in the temporal bone the diseased area was so well walled off that the increase of white cells was negligible. In these cases the headache, due to pressure, was always present and was a great guide to the surgeon. The headache of course did not necessarily mean mastoid disease, for it is a constant associate of almost all sinus infections.

Blood counts.—On 50 cases of acute mastoid infections the blood counts showed an average of 13,350 whites; those caused by streptococcus, 14,060 whites; those caused by pneumococcus, 11,025 whites.

Organisms.—The organisms taken from the mastoid cells at time of operation showed, in 50 cases: Streptococcus, 38 or 76 per cent; pneumococcus, 8 or 16 per cent; mixed infections, 4 or 8 per cent.

Radiograms.—One of the most important aids in diagnosis in mastoiditis is the X-ray. In a series of radiograms, Lieutenant Kirkline, who conducted that branch of the work in the Surgical Section, demonstrated that there is a marked symmetry of the two sides in the normal mastoid; the cellular structure of the right side is almost identical with that of the left. Pathological changes were always demonstrated; even slight changes in the cellular structure were demonstrable. This is of great advantage to the operator in giving him a fair idea of the extent of the diseased process. After the case is up and about it is well to have a second radiogram to show the completeness of the operation; also the return of one symptom, a persistent headache, is the indication for another radiogram. The radiogram will show; (1) The symmetry of the two sides; (2) the appearance of acute mastoiditis; (3) chronic mastoiditis; (4) post-operative results, faulty; (5) post-operative results, good.

TREATMENT

Two points of interest have been noticed with reference to treatment: (1) Regarding the use of Carrel-Dakin solution and dichlorazine paste; (2) serum treatment.

Carrel-Dakin solution is of great help in cleansing the wound of secretion.[1] Its use constantly causes great irritation to the middle ear, tympanum and canal, but it may be used every second or third day with safety. Dichlorazine paste is very effective in the after care of the

[1] It would be interesting to know definitely as to the preparation of the Carrel-Dakin solution employed in these cases—as to whether exact titration was used to determine the chlorine content. Carrel has always claimed that this solution, when the normal titre is used, is non-irritating.—Editor.

wound; it should be used fresh, beginning with the third dressing. It is easily applied and causes no discomfort, aids in the granulating of the wound keeps down the odor, and hastens recovery.

Serum.—All cases of blood stream streptococcus infections should be given antistreptococcus serum intravenously for several days after operation. It is best given in 25 c.c. doses every three or four days; there is but little reaction, and it is remarkable how quickly a fall of temperature will follow.

CONCLUSIONS

1. The tonsil plays an important rôle in the etiology of mastoiditis of acute type.

2. A primary focus developing in the mastoid area is of acute onset; rapid destruction of bone is the result.

3. Other foci of infection frequently occur at the same time, such as pneumonia, meningitis and toxic joints.

4. The most reliable diagnostic symptom during the entire course of mastoiditis is the persistent headache.

5. The value of radiograms before and after operation depends upon the technique and interpretation. They should form a part of the preparation for operation and of the after treatment.

6. Meningitis due to extension from the mastoid has been very rare in our series.

7. Meningitis due to blood stream infection of the streptococcus type frequently occurs in those cases where the mastoiditis is also due to blood stream infection.

8. Exposure of lateral sinus and dura and breaking through of same during operation are not serious accidents, but, of course, should be avoided where not necessary.

9. Ligation of the jugular should be anticipated at any mastoid operation.

10. Carrel-Dakin solution and dichlorazine paste are of great benefit in the after treatment.

11. Serum treatment is of no avail when the radiograms show involvement of the cells; it is of great benefit after operation when a septic temperature follows.

MASTOID OPERATION UNDER A LOCAL ANESTHESIA; REPORT OF FOUR CASES

By E. D. TWYMAN, M.D., and A. A. S. GIORDANO, M.D.

(With three illustrations)

Case No. 1: Ormund Ormundson. Permit No. 1392, sailor, aged 29, entered 10–22–'19. Acute mastoiditis superimposed on influenza with broncho-pneumonia. White count 20,000, of which 86 per cent were polymorphs. The ear was lanced, but the mastoid condition did not improve. Nineteen days after admission mastoidectomy was done under local anesthesia, consisting of injection of ½ per cent novocaine solution with adrenalin plus the administration of two hypodermics of morphine sulph. (gr. ¼ one hour before operation, and gr. 1/8 one-half hour before).

X-ray of the left mastoid showed diminished radiance (Fig. 1). Cultures of the pus showed staphylococcus albus. Recovery and healing were continuous and satisfactory.

Case No. 2: Adolph Flamein. Permit No. 1422, sailor, aged 21, entered 11–5–'18. Four days previously began to have mastoid symptoms, complicating the influenza and broncho-pneumonia already under treatment. He was transferred to the surgical side November 15, 1918, and operated on by the same method as Case No. L. X-ray of the right mastoid demonstrated the involvement by diminished radiance (Fig. 2). Cultures staphylococcus albus. Recovery was satisfactory and complete.

Case 3: Chas. Mabie. Permit No. 1720, sailor, aged 21, admitted 11–26–'18 with influenza, broncho-pneumonia resulting. Otitis media developed 12–8–'18 the drum rupturing next day spontaneously. December 11, 1918, the mastoid symptoms were acute and alarming—temperature 40.6° C. As the plate is broken the X-ray report of Maj. A. D. Foster is appended: "Radiological examination shows diminished radiance in the right mastoid region, indicating pus or granulation or both in the mastoid cells." Staphylococcus albus was reported on culture. Operation was done as in the previous cases. There was recurrence of fever four days after the operation, subsiding the second day after. Further recovery was uneventful.

Case 4: Michael Wirth, draft soldier, aged 23, permit No. 1867, diagnosis epilepsy and chronic otitis media with sclerotic mastoiditis. He was operated on by the same plan on November 27, 1918. The bone was very dense; the wound healed well. The epileptic symptoms were not relieved. X-ray showed sclerosis (Fig. 3).

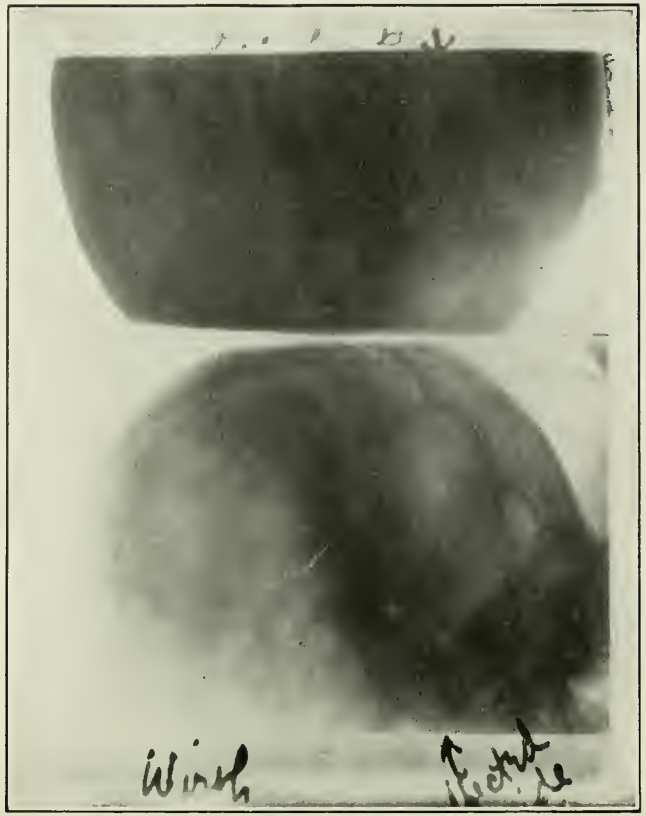

Fig. 3.

extensive. The ossicles were not removed. The cavity was packed with iodoform gauze without sutures. In three of the cases, no ligatures were required for bleeding. Very little complaint was made by the patients during the work. The rongeour did better than the chisel and hammer, on account of the jarring of the head. There was little after pain, none of the patients requiring additional morphine. These patients demonstrated for us the competency of their respective facial nerves.

EDITORIAL

A TRIP TO MARS[1]

In the Greek and Roman theaters, the mask of Tragedy with down-drawn mouth and scowling brow was counterbalanced by the grotesquely smiling face of Comedy. Fortunately, there is a funny side to most things, and in the midst of pain and sorrow and distress there is almost always somewhere a glint of the lighter side. What a good thing that it is so! Man could hardly struggle through all life and its burdens and anxieties with heart bowed down in woe. This same saving grace of humor keeps the balance just and cushions many of the sharp corners.

The report which we publish herewith is truly unconsciously funny. Of course it was a tragedy to the youngster who struggled with his refractory charges, despaired at delays and tried his best to meet situations which probably seemed to him as the camel did to the countryman when he remarked, "Hell! There ain't no such animal!" Those of pessimistic trend should not accept this tale of woe as an index of the way things were done "over there." Hard situations were met with forethought and resource, and work which could not be accomplished *was* accomplished. We have in this report of transport the narrative of a young man who started out to do a piece of work to which he was unaccustomed. What is to the point, he did it, suffer though he might in the doing, and we are sure that by the doing of it he was thereafter a better and more resourceful officer. Trials add to the strength of those who are tried.

The reading of it puts us in mind of Kipling and his "Big Drunk Draft," and we have wondered if by any chance this American youngster was fortunate in having any saving Mulvaney rise up from alongside the right of way and direct his feet in the path they should tread. Perhaps, and probably not. If so, then the more glory to the youngster that he should have wrestled his ambulatory convalescents to their

[1] In justice to the French as well as ourselves, it might be well to say that this was a very unusual experience. The train was not a hospital train—it was just an ordinary improvised troop train and, in furnishing it on our request, the French could not guarantee a fast schedule or direct route to Mars. Under ordinary circumstances the trip could have been made in twelve hours. These convalescents were sent from Chaumont to Mars in order to provide additional space near the front for battle casualties flowing in in great numbers at that time. In fact traffic was so congested that trains on the main lines were running on twenty-minute marches, *i. e.*, a train coming through a fixed station every twenty minutes. It is quite evident that the roundabout route followed, prescribed by the French for this special train, was an attempt to avoid main lines of traffic. Lastly, it should be said that one of the great achievements of the war was the efficiency with which the French utilized her limited railroad resources and coördinated the traffic activities of all the Allies fighting in their contiguous territory.—A. D. Tuttle, *Colonel, Medical Corps, U. S. A.*

ultimate destination all by his lonesome self. When we read the things which happened in this deliberate journey, one after the other with discouraging persistence we are inclined to view the trip as Joe Webber did the comments of his tall associate Lew Fields. After the latter had enlarged and elaborated on his mental, moral and physical shortcomings until he was entirely out of breath, his little partner looked up at him and in a complacent tone of voice asked, "Well, aside from that I am all right, ain't I?" And so, aside from the many tribulations which beset his passage, this young medical officer did in the end turn over his charges to their destination. More power to his arm next time.

We invite attention to the footnote and would say that it carries our opinion also. The narrative set forth carries no stigma to our good friends the French, and I know many whose sense of humor would be appealed to by it.

JAMES ROBB CHURCH.

HEADQUARTERS BASE HOSPITAL 15, A. E. F.

5 September, 1918.

From:
To: The Commanding Officer, Base Hospital 15.
Subject: Report of trip to Mars with patients.

1. The convoy consisted of one medical officer, a sergeant and seven men of the Medical Corps and 388 convalescent patients, starting in nine cars, one a double car.

2. Left Chaumont about 8.30 a. m., August 30. Train pulled out before patient's rations were loaded. Conductor, who was of the Engineer Corps of the A. E. F., was notified that the rations were not on board and agreed to switch the train over to track No. 1, where the rations were at the time, to load them. The train pulled out into the yard and backed into another track, picking up another detail of American troops, and then pulled out immediately, refusing to stop or return for the rations to be loaded. Rations were placed immediately on an ambulance, which overtook the train 10 or 15 miles up the line where the rations were taken on board.

3. The train proceeded slowly. Late in the afternoon Nuits-sous-Ravieres was reached, at which place we were side-tracked for five hours. Bread was short here, and I purchased 74 francs worth from French authorities.

4. After this stop of five hours, instead of being routed to Nevers we were directed toward Paris. When we arrived at Sens it was discovered by the French authorities that we were on the wrong road. At this place we were side-tracked for seventeen hours and our engine detached; reached there at 3 a. m. and left about 8 p. m.

5. Food supplies were exhausted before reaching Sens, so upon request the French authorities issued a half ration for 397 men, for which no charge was made.

6. At Sens I made repeated inquiries of the French *Chef de Gare* as to when we could leave. He gave me no satisfactory answer as to when an engine could be procured. During this seventeen hours I counted more than one time six idle engines in another yard, just across a fence. When asked if one of these engines could not carry us away I was told that they belonged to another company and could not be used for this purpose. On asking why we could not be sent out attached to another

French train I was told that we had too many cars to be handled thus and not enough for a special engine, so we would have to wait until they could make up a whole military train. After about fifteen hours at this place I called the American R. T. O. at ———, who immediately got in touch with American headquarters at Tours, reporting the state of affairs. I left word for him to call me through the French Military *Chef de Gare* and report as to what could be done toward getting us out.

7. A couple of hours later I went back and called him again; the French captain in charge of military dispatching was in the office at the time and, hearing the conversation, immediately began inquiring what we wanted. Upon telling him personally the state of affairs and how long we had been there, he asked why we had not let him know it before, saying that he was in charge of the dispatch of military trains and could have gotten us out at any time. He then gave us instructions, before hearing from American headquarters, to board the train immediately, saying that he would have us out in twenty minutes. In about an hour he had us switched over to the other yard where the idle engines had been standing, and about two hours later we were pulled out. The captain seemed to be disturbed because we had inquired of the *Chef de Gare* instead of him as to how to get out. He seemed to think that he had been disregarded in the matter. I thought that it was his place to look after us rather than ours to look him up, if he were in charge of the military trains passing through the station.

8. Alongside of us during these seventeen hours of waiting at Sens was a French military train, while another detachment of French soldiers was attached to our train; also, alongside was a trainload of wine. While I was down at the station office inquiring as to when we could get out, a French officer reported to me that my men were tapping the wine casks on the train alongside ours. I asked him to put on a guard, which, after a long while, he agreed to do. Upon investigating the matter I found that the French soldiers were drinking the wine, or taking it and selling it to our men. The latter seemed to tire of buying and, realizing that the wine did not belong to the French soldiers, then joined them in purloining and drinking it. This I put a stop to on returning to the train.

9. From Sens we proceeded to Montargis, ariving there about 1 a. m. of September first. We were sidetracked in that town for five and a half hours. One of our cars going bad was taken off here, and the men doubled up in the remaining cars.

10. We pulled out at 6.30 a. m., arriving at Nevers at 11.45 the same morning. The engine was again detached. At this time the convalescents had not had food for twenty-four hours and were very tired and hungry. Some were given permission to visit the Red Cross house for coffee and sandwiches, which they were informed would be furnished them there. I told the boys to remain near the train while I went up to the American headquarters in Nevers to procure rations or another engine to pull us out of there. We were told that we could not get out until 5.30 p. m. The American quartermaster supplied us with four hundred rations. Upon returning to the train I found that about two-thirds of the men had left it; some had gone to town, some to the Red Cross, or to any place where they thought they might obtain food. Those remaining at the train discovered on a nearby track a French car loaded with grapes, cheese, sardines and other food supplies, which car they broke into and made use of the food contained therein. I counted fourteen baskets of grapes, two of tomatoes, four crates of sardines and two of cheese that had been opened and the contents consumed. The American quartermaster came down and took a report of this.

11. At this place (Nevers) our train was backed into the yard on the wrong side

track, three cars being derailed. It being impracticable to keep the men in these derailed cars, and almost impossible without an armed guard, I requested that the American quartermaster captain taking a report of this damage furnish me with an armed guard; this he refused to do. Guards placed on duty without arms proved of little benefit, and the only way the men could be controlled was by standing there personally and doing it myself.

12. Finally, when the train was pulled into the Nevers station, it was learned that all the men had not returned, and some of those who did return were drunk or drinking. A detail was sent out into town to round up the absentees and make them return; most of them complied with the demand. The train left this station at 6 p. m. of the day of arrival (September first) and reached Mars, *a distance of about* 10 *miles*, at 1.30 a. m. of September second.

13. The three cars, including the double one, which had been derailed at Nevers and rendered unavailable for further use, were taken from us and one very small car supplied us to replace them. This left seven cars in which to complete our journey, and, in addition, at Nevers eighty-two other patients and two men were added to our detachment to be transported on the same cars. It being impossible to put all the patients in the cars, many were forced to ride on the running board of the cars and the engine, making the trip difficult and dangerous.

14. There was quite a little scrapping among four of the men on the way from Nevers to Mars, details of which were reported to the authorities of Base Hospital 35, at Mars, the necessary proceedings to be carried out by them.

15. The railroad station at Mars is about 1½ miles from the hospital. The hospital locomotive was not fired up, consequently trucks and ambulances were sent down to transport patients who could not walk up to the hospital. This was completed at 3.30 a. m. The patients being tired and hungry and the hour inconvenient, they were permitted by the receiving officer of Base Hospital 35 to go into the wards and retire without being checked in or formally received.

16. About twenty of the patients who did not report back to the train before we left Nevers came down by train early next morning (September second) and reported at the hospital.

17. Two other details of patients arriving at the same time with our main detachment caused quite a lot of trouble in checking up the next day; this necessitated our remaining at this post twenty-four hours for the final report and receipt for our patients. It was ascertained from the morning report of September third that all of my patients in round numbers except two were present. I got a receipt for the number, though not one according to names, and the registrar stated that he would send me by mail, in a few days, the names of the two patients still absent.

18. The buckets and cups which were taken with us had been distributed in the different cars. Many of them were found to leak on account of the bottoms coming unsoldered and were left in different towns by the patients and the men who used them for carrying water. Only three were observed to be on the train on arrival at Mars, two of which were leaking. These the quartermaster of the hospital said that he would gather from the train, as well as anything else left by the patients.

19. Sergeant —— was placed in charge of the seven men of the Medical Detachment and directed to board an American express for Chaumont, which was due to pass through Nevers the night of September third—at 1.17 a. m. This train did not run at all, so the military police then gave the sergeant a return *ordre de transport* by way of Paris, it being impracticable for the party to wait twenty-four hours for another express. They reached Chaumont the night of September fourth-fifth.

20. After obtaining my receipt and learning that there was no possibility of obtaining a seat on the American express, which was then twenty-four hours late, I boarded the Paris express, which arrived in the capital at 8 a. m. September fourth. I left at 8 p. m., arriving in Chaumont at 5 a. m. September fifth.

21. The above is practically a detailed report of my trip with hospital convalescents from Chaumont to the Hospital Center at Mars.

22. Hereafter it is recommended that hospital trains of this size of convalescent ambulatory patients be furnished with not less than four armed guards, it being practically impossible for enlisted men not armed to control them.

23. To save unnecessary delay in checking up patients delivered in mass to other hospitals it is recommended that an alphabetical list accompany the patients.

Signed, ————,
1st Lieutenant, M. C.

RESTORATION OF THE RECORD OF COLONEL JOHN VAN R. HOFF, MEDICAL CORPS, U. S. ARMY, RETIRED

It is with pleasure that THE MILITARY SURGEON learns of the restoration of the military record of Col. John Van R. Hoff, M. C., U. S. Army, Retired, formerly Associate Editor of THE MILITARY SURGEON, and there is no question that the same news will be equally gratifying to all his friends, which is to say, those who know or have known him. This information is contained in the subjoined memorandum from the Secretary of War to the Chief of Staff:

WAR DEPARTMENT
WASHINGTON

December 20, 1919.

MEMORANDUM FOR THE CHIEF OF STAFF:

In July, 1918, Colonel John Van R. Hoff, Retired, then editor of THE MILITARY SURGEON, published an editorial in that magazine which was brought to my attention as being subversive of the sort of cooperation which ought to obtain in the military establishment in the period of active hostilities. By my direction a reprimand was administered to Colonel Hoff (see paragraph 86, S. O. 179, W. D., 51, 1918).

Under date of November 11, 1919, Colonel Hoff wrote to the Adjutant General of the Army on the subject of the withdrawal of the reprimand, and requested not only the withdrawal of the reprimand but his own restoration to active duty.

I have examined this whole question afresh and in the light of the more composed situation which exists now that the war is successfully terminated. I am clear that the caption of the editorial was unhappy, and that the body of the editorial might well have been misunderstood, but I am satisfied that the intention of Colonel Hoff's editorial was not undisciplined and antagonistic. In view of Colonel Hoff's long and honorable service, I desire to withdraw the reprimand and to have the withdrawal officially entered upon his record. In view of the fact that the Army is now substantially demobilized and retired officers are not needed in active service, Colonel Hoff's request for active service is denied.

(Signed) BAKER,
Secretary of War.

We congratulate Colonel Hoff upon the receipt of this letter and the removal from his record of a stricture which could not have failed to hurt, and we congratulate the Secretary of War on a lordly action in the doing.

Only those who have given many years of faithful service in the uniform of their country (and Colonel Hoff has given nearly half a century) understand how precious a thing to a member of the armed forces is official reputation as sustained by the records of the branch which he serves.

This act of justice to an old and faithful soldier seems particularly happy at this season and we take this opportunity to congratulate Colonel Hoff upon the outcome and to wish that there may be for him many more years in addition to those which already stand in the record of his long, and honorable, and useful life.

THE EDITOR.

CORRECTION OF AN ERROR BY OUR PRINTER

On page 734 of the December issue, the title of the first Vice-President should be Surgeon J. W. Kerr, U. S. P. H. S., instead of Surgeon General J. W. Kerr, U. S. P. H. S. This, as well as other errors which appear in the same issue, are due presumably to the labor trouble which has been prevalent in all printing establishments throughout the country and to which the tardy appearance of the December issue must be charged.—THE EDITOR.

ASSOCIATION NOTES

At a meeting of the Executive Council of The Association of Military Surgeons, November 14, the following names were proposed and elected to membership in The Association:

Medical Corps, U. S. N.

Lieutenant

Royal Knight Joslin

Medical Corps, U.S.N.R.F.

Lieut. Commander

Rutherford B. H. Gradwohl

Lieutenant

Richard P. Landis

U. S. P. H. S.

Assistant Surgeon (Reserve)

Clifford C. Oliver

Medical Reserve Corps, U. S. A.

Colonel

Robert B. Osgood

Majors

Louis M. Tomlinson
John Wehrly

Captains

Earl E. Heath
Baldwin L. Keyes
Dwight E. Long
Harry H. McClellan
Roger S. Parry
Frank Gay Sanders

First Lieutenant

Frank Andrew Mack

Medical Corps, U. S. A.

Majors

Raymond Clark
Henry B. Hitz
Frederick C. Kidner

Captains

Floyd L. R. Burks

Captains—Continued

George L. Converse
Duncan McI. Draughn
Edwin Eugene Endicott
R. R. Hogue
Foster C. Howard
James R. Hudnall
Karl H. Kellogg
Ward Holmes Leonard
George Mossman
Irvin A. Weichbrodt

First Lieutenants

John Browning Baldwin
Paul E. Beach
Ray Harmes Bechtell
Harry James Blount
Evans Lewis Huggins
John H. Revington

COMMENT AND CRITICISM

Col. Jas. Robb Church,
Army Medical Museum,
Washington, D. C.

Dear Sir:

Your editorial in the November issue of The Military Surgeon was pointed out to me by a friend who got the impression that it applied to our Army. Before I had seen the editorial, I entered into quite an argument with him, stating that all War Department reports pointed to the fact that no men were executed in the A. E. F. for crimes other than civilian crimes, and that the men so executed were hanged. The Judge Advocate General's Report for this year also indicates this to be a fact.

Having read your editorial, I realize that it applies to the Army of Great Britain, based as it is on the report of the *United Service Gazette*, but I still believe that some American readers would get the idea that some of our soldiers were executed for dishonorable behavior or cowardice under fire. My suggestion is not intended to be critical but merely to indicate to you the fact that some people are associating the editorial with our troops in the A. E. F.

Yours very truly,

Carl H. Butman, *Director,*
War Department News Bureau.

HOSPITAL SANTO TOMAS

On Saturday, November 15, the ground was broken by Doctor Belisario Porras, President of the Republic of Panama, for the new Santo Tomas Hospital, which is to be located in the suburbs of the city of Panama. A fitting and impressive ceremony was performed. The new institution, which will be in charge of Maj. Edgar A. Bocock, M. C., U. S. Army, is being constructed on the administrative plan by a commission of five members nominated by the President of the Republic to accomplish the construction work. The layout is contemplated to accommodate 600 patients and will be built of reinforced concrete and concrete blocks throughout.

The estimated cost of the new institution will be approximately $600,000. Separate hospitals for the care of tuberculosis, venereal and contagious diseases are included in the plans for the new institution. The equipment will be most modern in character and will include up-to-date X-ray facilities as well as electro and therapeutic apparatus.

IN CASE OF INTERVENTION

Under a recent date line, a responsible writer in the *Washington Post* had an article on the front page of that well-known morning daily about Mexico. The article was unusually frank and direct. It stated in effect that intervention in Mexico by the United States at an earlier or later date (this was early in November, 1919) is a foregone conclusion; that plans for the same are going forward in the appropriate government departments. It seems that reverse English was being put on the Monroe Doctrine by certain foreign friends of ours who say to Washington, "You won't let us do it, so we're looking to you," or words to that effect. Also the United States is not without certain direct provocations extending over a considerable period.

Intervention in Mexico, if it comes to pass, is not likely to be merely a matter of a few months; a few years is more probable. During that time many thousands of men will be needed; troops for the advanced zone, the line of communications, at the base. There will be many problems in the event of such intervention, among them the very genuine one of venereal disease control. The Army knows there was enough need for such work in France. Ample need for it was found during the mobilization of the National Guard in 1916, and later during the mobilization of all the forces for the World War. The problem of the southern border cities and communities in this regard was not simplified by their Mexican population.

With the definite possibility looming ahead, intervention suggests the consequent need for venereal disease control measures. It suggests the question, "What can be done? What is being done?"

Did you ever notice on those communications you get from the Army the cryptic numerals and letters on the margin. That's the sign manual of the Army's numerical filing system. Anything the U. S. A. marks 726.1 ultimately will come to rest with the papers on venereal diseases. Owing to the Army's activities along lines of venereal disease control during the late general debate in Europe, Drawer 726.1 is a pretty full one, too. Now, while things are quiet, the contents of that drawer might be scanned and a few plans laid for special use. When and if the need arises, there will be a plan at hand and material on which to act without the loss of time incident to planning under pressure.

With the information now at hand on fighting the venereal plague, we can prepare to be fully ready when the time comes for using that knowledge. There wasn't much preparation in the Army along this line in 1917. The first troops overseas, the pick of our fighting forces, were not reached then by the special army instruction in the knowledge and avoidance of these diseases. It is well that the Y. M. C. A., with their

Mexican border experiences fresh in mind, were on the job. Once "over there" the early divisions got so far ahead of the whole army program of instruction against venereal diseases, that they didn't begin to hear about it until after the armistice.

These diseases, the results of willful exposure, rob an army of more of men's services than any other peace-time cause of disability. But it is not the army alone that suffers. Army discipline aims to keep the contagiously infected quarantined; but, despite the sincerest efforts, the civil community is liable to suffer some spreading of the diseases. Concentrate an army for intervention in the southern part of this country; will the lure of the uniform be as strong as ever? Will its wearers enjoy a special regard? Will those who prey on the sex instinct seek the neighborhoods of the camps, as near as the laws will allow or ingenuity permit? And will the soldiers be excited by the military prospect, a little disorganized in mind, a little less careful socially? With the answer you will also have the reason for getting ready—or not.

Possibly you remember the indefatigable German youngster in Mr. Britling's care; and how he told that harassed gentleman that England would lose the war because the English didn't know how to use the information they had? In the present case of possible intervention, the idea is to get ready for the best possible control of the venereal disease problem by using the information we have. Get ready for the next move whether it be intervention in Mexico or any other activity the General Staff may indicate. If any feature of fighting venereal diseases can be added to what is becoming known as "The American Plan," add it. But the American plan, embracing proper forms of recreation, law enforcement against vice, education, public health measures, and Prophylaxis is well matured. Its application to a southern troop concentration could well be preceded by a few hours of special thought and more hours of material preparation. As a basis for consideration and as an exemplification of the thought behind this article, the following suggestions may prove interesting:

A. Personnel.—In carrying out an active fight against venereal diseases in the event of intervention to the south of this country, officers would probably be needed at the following stations: Washington, D. C.; Headquarters, Southern Department; cities along the border; key cities in the home country with expeditionary headquarters. The personnel to supplement the Regular Army officers for these posts could be selected now from the reserves experienced in the work. A tentative assignment on paper could be given. Alternates for the more important places should be listed, for all the experienced officers will not return to a job like this. There is, however, information on hand at the Surgeon General's Office to show which ones will accept.

B. The General Plan.—Prepare a draft of a news article to be released at the appropriate time through the press. This account should set forth the needs of the hour for perfect civilian support of the Army's efforts to deal with the venereal diseases before harm is done the soldiers. Some praise of the work done in the Southern Department (and elsewhere) along control lines during the World War might well be included, together with pointed mention of the defects then uncovered. Sketch a brief review of the Army's plan, and include an announcement of the expectation of real effort at law enforcement by municipal, county and state officers. A series of such articles issued authoritatively, explaining the Army's objectives in controlling syphilis, gonorrhea, and chancroid and asking for public support should be effective.

C. Recreation for Troops.—(1) Study and list now the forms of sport and recreation found most successful in that climate during the two previous mobilizations in that area.

2. Schedule for the above the requisite paraphernalias on the basis of regimental needs.

3. Outline a model recreation and athletic program for one winter and one summer month.

D. Public Health Measures.—Maintain close liaison with the Public Health Service, especially as regards its work of fighting venereal infections along the Mexican border.

E. Prophylaxis.—The value of prophylaxis is undergoing close scrutiny and analysis. The results determined by the Surgeon General's Office may be made public later. In the meantime, however, the names of the enlisted men of the Medical Department proficient in the technique of actual administration of prophylactic treatments, in the care of stations, equipment and records, should be a matter of convenient record.

F. Education.—(1) Prepare at least two new sets of slides for the automatic stereopticons, based to some degree on the known facts regarding the prevalence of venereal disease among Mexicans. Illustrations should be obtainable from border city clinicians. Lieut. Herman Goodman, M. C., U. S. A., who has been indefatigable in applying American methods and ideals of venereal disease control in Porto Rico and later in the Panama Canal Zone, should be of real help in this work, after his experience with mixed Spanish-descendant types.

2. Secure the scenarios, at least, for one or two moving picture stories, featuring Mexican scenes, the story revolving around the clean man, as in "Fit to Fight."

3. Prepare a new pamphlet of instruction and appeal to the individual

soldier. Give him in this the facts about the diseases themselves, but weave into in all the local color and historical interest that can be gleaned from the files on the Mexican War, the late Punitive Expedition, and the present objectives. Make it timely. Put pictures in it. Put some spark in the title and some colors on the cover. The proper kind of pamphlet will be read by the veteran as well as by the rookie, often more than once, and then, as in the World War, mailed back to some chum at home.

4. A pamphlet should be ready too for the men who will file through the receiving office into the venereal disease wards of the army hospitals—in a thinner stream than ever before in any army's history—but inevitably some. Such men need at least two things that a pamphlet can give: viz., a word on which they may build hopes of reasonably early recovery, and strong advice as to the necessity for the completion of treatment, however long, regardless of whether they stay in the service or get out before treatment is finished.

6. A broader and more far-reaching work along education lines might well be undertaken. Col. P. M. Ashburn's overseas study of the "Factors Making for a Low Venereal Disease Rate in the A. E. F." contains interesting conclusions that may be applied practically. Incidentally there is enough in that study to make American parents and teachers glad of the foundations they helped lay for those same boys that the colonel's study reached. They withstood attacks more insidious than the most fiendish gas; 3,000 miles away from home, alone, they won those battles with self in the dark, when voices within, without, urged them to the betrayal of their high ideal. Colonel Ashburn's report shows that the factors that kept American boys clean primarily were not prophylaxis, not punishment, not threats, not army regulations, not lectures. These were helpful in varying and minor degrees. The principal factor in this fight was character, the ideals the Yanks brought with them, something they had got long before they put on olive drab and were allotted an army serial number.

The average age for the Army during the world war was well above twenty-one years, and by that time a man's sex habits have been decided one way or the other. The effective age at which to influence that decision is long before twenty-one. Education in the knowledge of venereal diseases, their effects, and the numerous reasons for their avoidance is still effective, but certainly not at its maximum, at the age of twenty-one. So it is not claimed that the principal factor in keeping the venereal rate down in the American Army (and giving us another victory to be proud of) is an army product altogether. The large percentage of American soldiers avoided exposure to venereal infections

because they remembered the training of their boyhood and of their adolescent years. They had a pride in their clean record. There was a "one hundred per cent" girl back home they were going to be worthy of. In many cases there was a wife and children to be loyal to and keep clean for. Reasons like these are the principal factor in making for a low venereal disease rate in France as found by Colonel Ashburn's study. Isn't the concentration of effort on the formation of character by the proper education along sex lines indicated by these findings? Certainly it would pay dividends far above increased numbers of effectives for military purposes. It seems that the above facts should somehow find nation-wide use through the Federal Bureau of Education and the United States Public Health Service, in furnishing the boys and girls in the late grammar school grades and in the high schools intelligent and sympathetic instruction in these matters at the time when they most need it and when it will be most effective.

There may be the germ of usefulness in one or more of these suggestions, but whatever the practical worth of these particular ideas, it is obviously desirable to formulate now a working basis for handling the menace of venereal disease in the event of military intervention in Mexico. With orders made ready now for the immediate calling to service of an experienced reserve personnel to assist the regulars who will handle this disease-group, a new record for promptness could be made. With plans for suitable materials well forward, the Medical Department of the Army could establish a new record for efficiency. The actual venereal disease-control resulting will be a dividend richly repaying today's investment.

NOTE.—Preparation of this article was commenced early in November, prior to the tension developed over the imprisonment in Puebla, Mexico, of U. S. Consular Agent William O. Jenkins, which case is now (November 26, 1919) the subject of serious diplomatic correspondence between the two governments.

SIDNEY MORGAN,
1st Lt. Sanitary Corps, U. S. A.

BOOK REVIEWS

THE ARMY BEHIND THE ARMY, by Major E. Alexander Powell, U. S. A. Illustrated. New York: Charles Scribner's Sons, 1919. Price, $4.00 net.

Major Powell was specially detailed by the War Department to write this work, and in the 470 pages which it comprises he gives us a most comprehensive and fascinating insight into the staging of the tragedy of war. In considering battles and campaigns we are apt to arrest our attention with the charging troops and the battery in action, taking for granted the means and methods which have made it possible for them to charge or fire. It is well to have brought to our attention the *vis a tergo* which, by painstaking prevision and prophetic foresight, makes effective the effort of the combatant troops.

Major Powell does this in regard to all the services which fall in the category of "auxiliary," and does so in such a way that we have a live narrative instead of a dry-as-dust marshaling of facts and figures.

From him we learn the why and wherefore of the Engineers, the Ordnance and the Signal Corps, of the Quartermaster and Medical Corps and the others which are the thews and sinews of the divisions in action. It is all readable and worth reading, and shows to the uninitiated that there is a methodical, hard working, inventive, resourceful background to those who fight and fall at the front.

The illustrations are numerous and instructive

As a medical man, we cannot refrain from quoting the following: "If America's losses in the greatest of wars were relatively slight—*and they were slight* when compared with the appalling casualties suffered by most of the other warring nations—the reason is not to be found in the superiority of American strategy, in the ability of American commanders, or in the excellence of American weapons, but in the efficiency, self-sacrifice, and devotion of the officers, nurses and men who wore the caduceus of the Army Medical Department. And I know whereof I speak, for I have not only visited French, British, Belgian, Italian, even German hospitals, all the way from La Panne to Montfalcone, thus affording me standards of comparison, but I spent nearly three months in an American hospital on the Marne, I came home on an American hospital ship, and for nearly three months more I was under the care of army medical officers in the United States. In dressing stations, field, camp, base, debarkation and general hospitals, I have watched the Medical Department at its work, and the first hand knowledge thus gained gives me the right to assert that it was the most efficiient service of its kind possessed by any army. To its officers and men, and to the devoted women of the Army Nurse Corps, I lift my hat in gratitude and admiration. The American Army and the American people owe them a debt which they can never fully pay."

JAMES ROBB CHURCH.

THOUGHTS OF A PSYCHIATRIST ON THE WAR AND AFTER, by William A. White, M.D., Superintendent of St. Elizabeth's Hospital, Washington, D. C. New York: Paul B. Hoeber, 1919. Price, $1.75.

Anything from the pen of one so eminent in his profession as Dr. White must command attention. In his little book, "Thoughts of a Psychiatrist on the War and After," he takes up and discusses from this standpoint the question of war and conflict both as to predisposing causes and the after effects of the condition itself. The book is divided into eight chapters which carry us from a consideration of the individual, with his personal tendencies and desires, through the evolution of the

laws and regulations which are to govern when a condition of altruistic supervenes that of egoistic hedonism. In this connection he discusses the mental changes which are for the governing of a group or nation in comparison with those which solely affect the individual. He makes use in this connection of analogies based upon the mind of the child, the criminal and the insane.

It is quite evident from Dr. White's analysis that he is by no means a pacifist, although it is equally evident that he regards war, as do most all thinking men, as a doubtful blessing. He considers, as must also the thinking man, that it carries with it the possibility both for good and for evil; that while it is primarily a tearing down of social institutions there lies back of this phase the upbuilding of newer and better ones; further, that it should necessarily be an advance, since in the upbuilding of any structure new material must be added as an essential adjunct to that which has been salvaged from the old. Thus in the reconstruction of a particular social fabric consequent on the termination of a war, better principles should arise from what was a destructive process in the beginning.

It is evident from perusal of this little work that Dr. White has given thoughtful consideration to that question which agitates so much of the public mind today—the League of Nations. It is also apparent that he holds no brief either for or against it, but limits both condemnation and commendation by the conditions which shall be resultant from the conclusion of the war.

He dwells upon the effect economically of the conduct of the victor toward the vaniquished, and it is his belief that the further shaping of the conquered power will be dependent upon the attitude of the nation which is in the ascendancy. The treatise is thoughtfully written and contains much food for reflection.

JAMES ROBB CHURCH.

EXPERIMENTAL PHARMACOLOGY, by Hugh McGuigan, Ph.D., M.D. Illustrated with 56 engravings and 7 colored plates. Philadelphia and New York: Lea & Febiger, 1919. Price, $2.75.

In all teaching in recent years, particularly along the line of medicine and the kindred sciences, the tendency has been to lay more stress upon the clinical and experimental phase than upon didactic teaching. This book fits in with this idea, giving as it does a series of experiments particularly fitted to the student of pharmacology. In conjunction with lectures and text-book, it should give very complete working knowledge along the line which it is designed to cover. It is systematically gotten up, thorough in arrangement, well illustrated, and should be of much value in connection with lectures on the subject.

J. R. C.

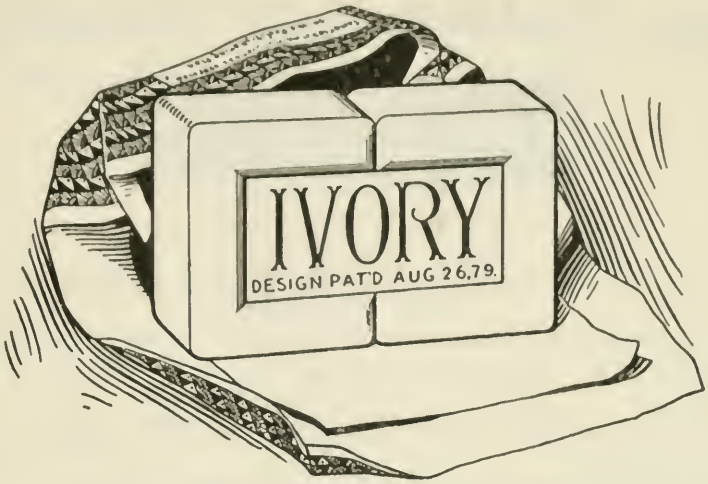

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Fig. 4—Pitcher, capacity 2 quarts.
Fig. 5—Dressing Jars, sizes ½, 1, 2, 3¼ and 4 quarts.
Fig. 6—Irrigators, sizes 1, 2 and 3 quarts.
Fig. 7—Irrigators, sizes 1, 2 and 3 quarts.
Fig. 8—Funnels, diameter top, 3⅛, 4¾ and 6¼ inches.
Fig. 9—Oval Seamless Tubs, sizes 11 and 16 quarts—17 and 19 in. long.
Fig. 10—Conical Mugs, sizes top, dia. 2¾, 3⅛ and 3½ in.
Fig. 11—Conical Tumblers, sizes top, dia. 2¾, 3⅛ and 3½ in.
Fig. 12—Dinner Plates, sizes dia. 7⅛, 7⅞, 8⅝, 9¼ and 10½ in.
Fig. 13—Soap Dish with Drainer, size 5⅜ x 4⅛ x 1⅛ in.
Fig. 14—Cups and Saucers, sizes, cups ½ and ¾ pints; saucers 6⅛ in. dia.
Fig. 15—Sputum Cup, size 3⅞ x 3¾ in.
Fig. 16—Oval Trays, sizes 10 x 8 x ¾ in., 12 x 9½ x 13/16 in., 14 x 11¼ x ⅞ in., 16 x 13 x 15/16 in., 18 x 14 x 1 in., and 20 x 15 x 1⅛ in.
Fig. 17—Round Medicine Trays, sizes dia. 8, 10 and 12 in.
Fig. 18—Oblong Serving Trays, sizes 8⅜ x 11¼ and 11¼ x 16¼ in.
Fig. 19—Pus Pans, Kidney Shape, sizes 6¾ x 3 x 1¼, 8 x 3½ x 1½, 10 x 5 x 1¾ and 12 x 7 x 2 in.
Fig. 20—Basins, size 10⅜ x 2¾, 11¼ x 2¾, 11⅞ x 3⅛, 12½ x 3⅜, 13¾ x 3⅞, 15 x 4, 15⅜ x 4½, 17¾ x 4½ and 19¾ x 5 in.
Fig. 21—Brush or Instrument Tray, size 8 x 3 x 1½ in.
Fig. 22—Eating Bowls, sizes 4 x 2⅝, 4¾ x 2¾, 5½ x 3 and 6¼ x 3¼ in.
Fig. 23—Sponge Bowls, sizes dia. by depth: 4 x 2, 5 x 2¼, 6 x 2¾ in.
Fig. 24—Bed Pan, 18½ in. long by 4 in. deep.
Fig. 25—Queen Bed Pan, 15 in. long over all, 12 in. wide over all, 4 in. deep over all.
Fig. 26—Instrument Trays, sizes 7⅛ x 5⅜ x 1⅛, 8 x 6 x 1¼, 9½ x 7½ x 1⅜, 16⅝ x 10¾ x 2⅜ in.
Fig. 27—Solution and Immersion Bowls, sizes 7 x 3, 8¾ x 3¼, 10¼ x 3¾, 11¾ x 4½, 12½ x 4½, 13½ x 4¾, 14¼ x 5, 15¾ x 5¾ and 17¾ x 6½ in.
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Fig. 29—Cuspidor, 7 in. dia. by 4 in. high.
Fig. 30—Cream Pitchers, capacity ½ pint.
Fig. 31—Male Urinal, seamed, capacity 1 quart.
Fig. 32—Female Urinal, seamed, capacity 1 quart.
Fig. 33—Bed or Douche Pans, Seamless, size 15¾ x 11¾ x 3 in.

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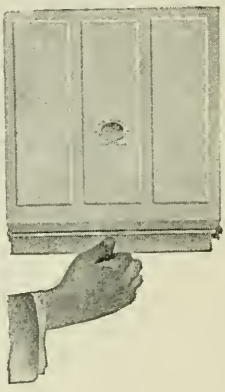

Health inspectors and registered nurses are appointed, their numbers being regulated by population. These officers must examine children in any cases where the parents waive their right to have their children examined. They must also inspect school buildings at regular intervals and report to the proper authorities any insanitary conditions that exist.

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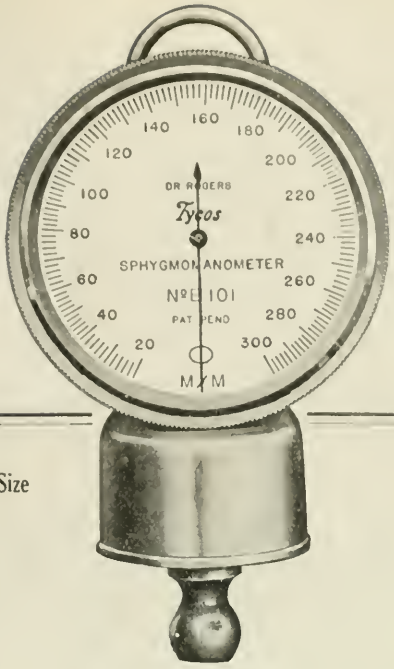

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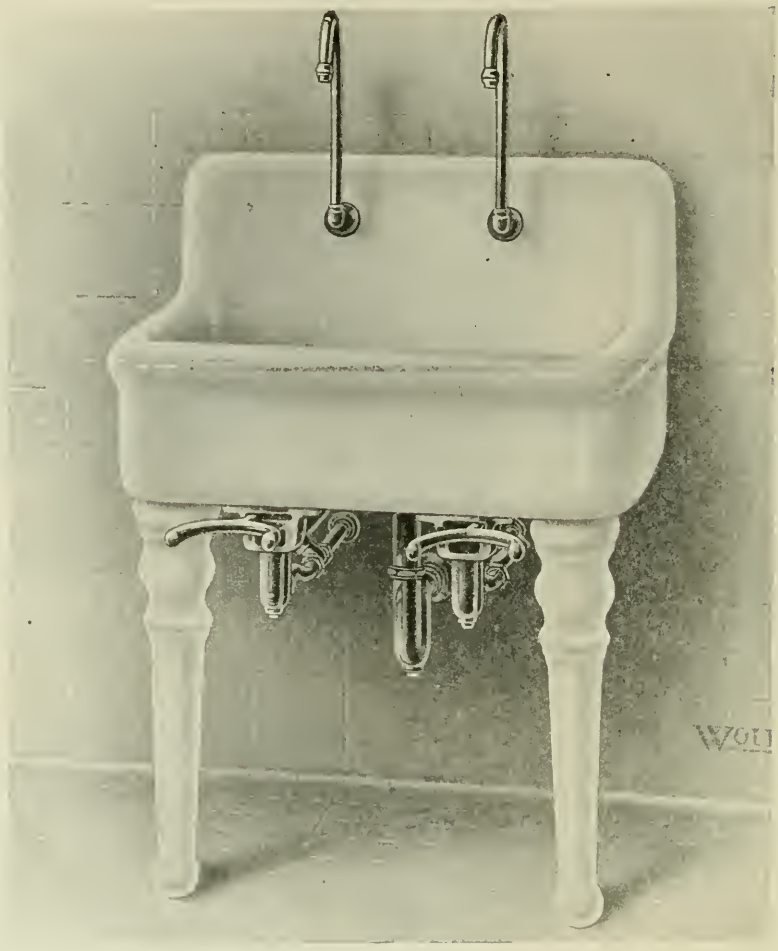

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